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ABSTRACT

This learning packet of hands-on activities was developed by the Duke Power State Park in North Carolina for grades 4-7 to acquaint students with the concepts of water quality, watersheds, aquatic sampling, water pollution, preservation of natural areas, and land use. The loose-leaf book is divided into these sections: (1) introduction to the North Carolina State Park System, Lake Norman, the Duke Power State Park, and the park's activity packet; (2) a summary of the activities including major concepts and objectives covered; (3) previsit activities introducing the use of a dichotomous key, familiarizing students with water-related words, and introducing the concept of watersheds; (4) on-site activities that teach students to recognize indicators of water quality, conduct simple physical and chemical tests, and note firsthand some factors that affect water quality; (5) post-visit activities that encourage students to examine conflicting land-use concerns, discuss ways water becomes polluted, become familiar with major types of aquatic pollution, and predict potential effects of aquatic pollutants on wildlife and people; (6) a list of 57 vocabulary words; and (7) necessary park and parental permission forms. Contains 25 references. (PVD)

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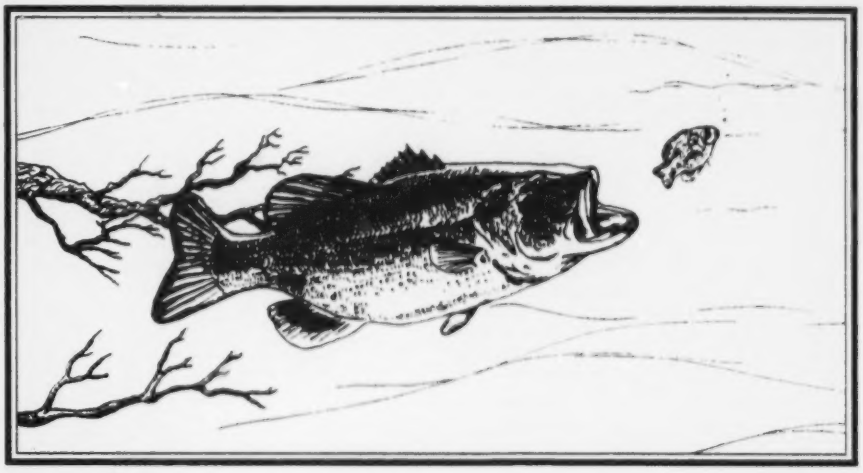

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Duke Power State Park

An Environmental Education Learning Experience

Designed for Grades 4-7

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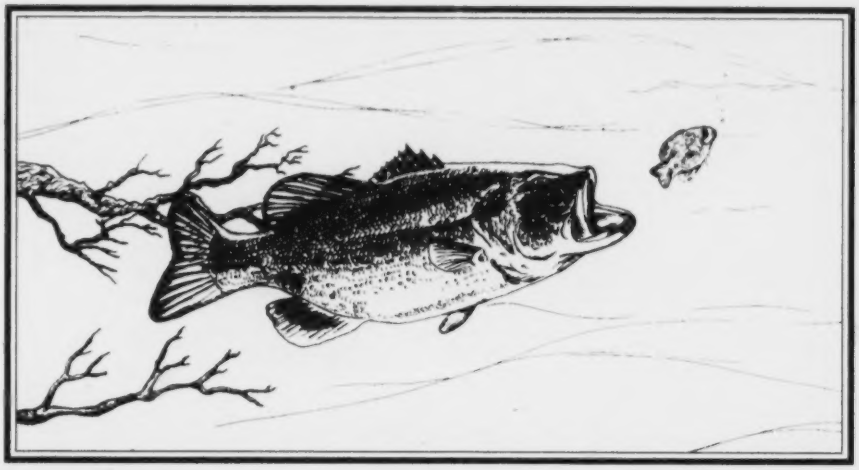

THE WATERS

Duke Power State Park

An Environmental Education Learning Experience

Designed for Grades 4-7

"Earth is home to us all.
Water is life to us all.
Share it responsibly."

North Carolina
Wildlife Resources Commission

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The N.C. Division of Water Resources;

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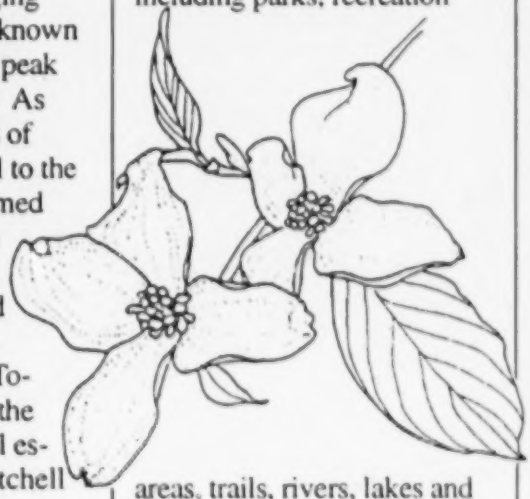
Introduction to the North Carolina State Parks System

Preserving and protecting North Carolina's natural resources is actually a relatively new idea. The seeds of the conservation movement were planted early in the 20th century when citizens were alerted to the devastation of Mount Mitchell. Logging was destroying a well-known landmark - the highest peak east of the Mississippi. As the magnificent forests of this mile-high peak fell to the lumbermen's axe, alarmed citizens began to voice their opinions. Governor Locke Craig joined them in their efforts to save Mount Mitchell. Together they convinced the legislature to pass a bill establishing Mount Mitchell as the first state park.

That was in 1915. The North Carolina State Parks System has now been established for more than three quarters of a century. What started out as one small plot of public land has grown into 59 properties across the state, including parks, recreation



areas, trails, rivers, lakes and natural areas. This vast network of land boasts some of the most beautiful scenery in the world and offers endless recreation opportunities. But our state parks system offers much more than scenery and recreation. Our lands and waters contain unique and valuable archaeological, geological and biological resources that are important parts of our natural heritage.

As one of North Carolina's principal conservation agencies, the Division of Parks and Recreation is responsible for the more than 125,000 acres that make up our state parks system. The Division manages these resources for the safe enjoyment of the public and protects and preserves them as a part of the heritage we will pass on to generations to come.

An important component of our stewardship of these lands is education. Through our interpretation and environmental education services, the Division of Parks and Recreation strives to offer enlightening programs which lead to an understanding and appreciation of our natural resources. The goal of our environmental education program is to generate an awareness in all individuals which cultivates responsible stewardship of the earth.

For more information contact:

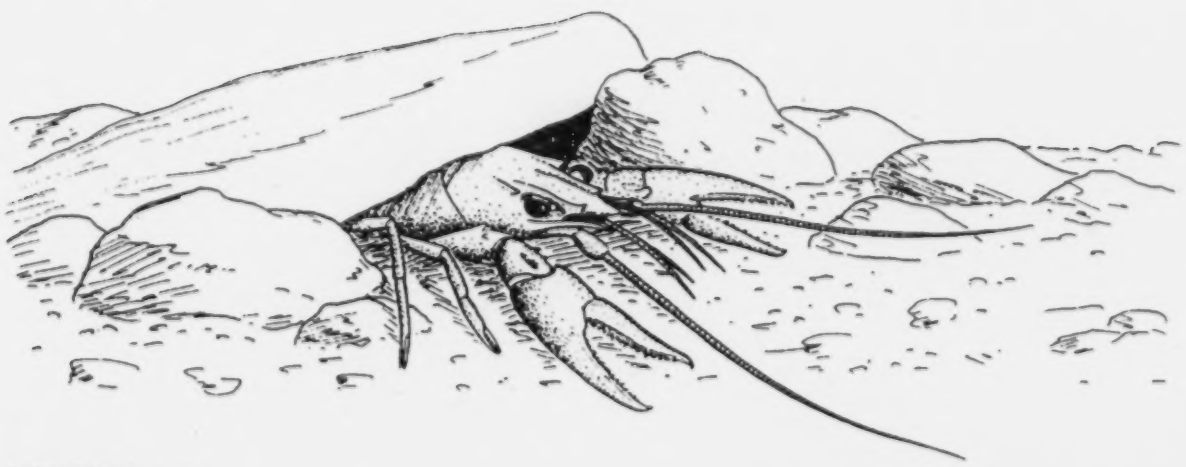
NC Division of Parks and Recreation
P.O. Box 27687
Raleigh, NC 27611-7687
919/ 733-4181

Introduction to Lake Norman

Lake Norman is one of 10 man-made lakes along the Catawba River; but it differs significantly in one aspect– size. In fact, Lake Norman is nearly as large as the other nine lakes combined! The larger of the lakes includes Lake James, Lake Hickory, Lake Wateree and Lake Wylie. When the lake is completely full, it covers 32,510 acres and has 520 miles of shoreline. It's no wonder the lake is nicknamed "the inland sea."

In 1959, 43 years after Duke Power Company announced plans to build the lake, construction of this enormous resource began. Four years later, Cowan's Ford Dam, located near Huntersville, NC was closed and the Catawba River began to back up and form Lake Norman. It took approximately three years to fill the huge basin created by the dam and another year to complete the entire Lake Norman project.

Today, Lake Norman provides electricity to the piedmont of North Carolina in two ways. First, it powers the hydroelectric generators at Cowan's Ford Dam and second, it cools the steam that drives the turbines of Marshall Steam Station and McGuire Nuclear Station. The lake also serves as a water supply for several cities and protects downstream areas from flooding. A variety and abundance of wildlife also benefit from the lake, including osprey, ducks and many species of freshwater fish, such as largemouth and striped bass and catfish. Not only do wild animals call Lake Norman home; over 26,000 people permanently reside along its shores and enjoy boating, fishing, and skiing.



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Introduction to Duke Power State Park

"Water, water, everywhere..." and there's plenty for everyone at Duke Power State Park, which is located on the northeastern shore of Lake Norman. As if there wasn't enough water in Lake Norman, the park has its own 33 acre lake, which is separated from Lake Norman by an earthen dam. But water is not all you'll find at the park; there are also about 1,500 acres of rich piedmont forest here, most of which was donated by Duke Power Company. Together, the lake and forest provide homes for a multitude of wildlife. Waterfowl, including ducks, geese, great blue herons and kingfishers are common sights around the water. Below the surface, you'll find a variety of freshwater fish, including largemouth and striped bass, crappie, catfish, and bluegill. On the park grounds there are white-tailed deer, red fox and groundhogs. The water and woods are also home to a variety of insects, amphibians and reptiles. Plant life is abundant; not only are there piedmont species, but several mountain plants as well, including mountain laurel and white pine. And don't forget to look up into the sky above the park, where you might see owls, woodpeckers, hawks and more than 100 species of migrating birds.

Of course, wildlife is not all you'll find at Duke Power State Park. There are also various recreational facilities available. These include two picnic areas, a picnic shelter, over six miles of hiking trails, a swimming area, rowboat and canoe rentals, and family and group campgrounds.

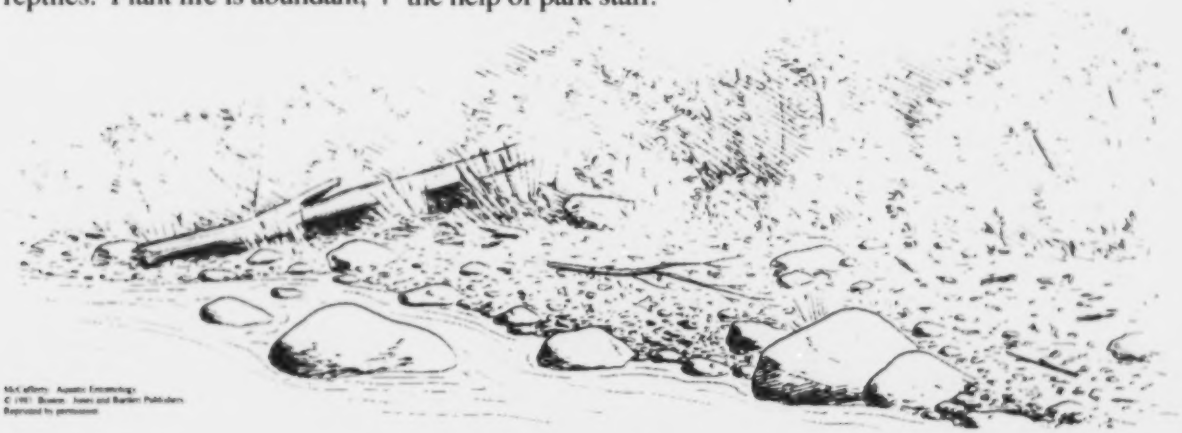
Guidelines for a Rewarding Experience at Duke Power State Park

Groups are encouraged to visit the park during all seasons of the year for hikes, exploration, environmental education programs and activities. Leaders may choose to conduct their own activities or request the help of park staff.

Scheduling a Trip

To make a reservation, contact the park at least two weeks in advance. Complete the scheduling worksheet on page 9.1 and provide the following information:

- Name of group (school).
- Name, address, work, and home telephone numbers of the group contact person.
- Date, time of arrival, and meeting place at the park.
- Departure time from the park.
- Number of participants and adult leaders. **A maximum of 30 participants is recommended. Please have one adult leader per 10 students. Adult leaders are responsible for maintaining control of the group.**
- Age range and/or special needs of participants.
- Desired activities; assistance needed by park staff.



McCafferty, Aquatic Entomology.
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While at the Park

Please obey the following rules:

1. To help you get the most out of the experience and increase the chance of observing wildlife, be as quiet as possible while in the park.

2. On hikes, walk behind the leader at all times. Stay on the trails. Running is not permitted.

3. All plants and animals within the park are protected. Breaking plants and harming animals is prohibited in all state parks. This allows future visitors the same opportunity to enjoy our natural resources.

4. Help keep the park clean and natural; do not litter. If you find litter left by others, please pick it up.

5. Swimming is permitted only in the designated swimming area under the supervision of park lifeguards.

6. In case of accidents or emergencies, contact park staff immediately.

Following the Trip

1. Complete the post-visit activity in the activity packet.

2. Build upon the field experience and encourage participants to seek answers to questions and problems encountered at the park.

3. Relate the experience to classroom activities and curriculum through reports, projects, demonstrations, displays and presentations.

4. Give tests or evaluations if appropriate, to determine if students gained the desired information from the experience.

5. File a written evaluation of the experience with the park. An evaluation form is available on page 9.3.

Park Information

Address:

Duke Power State Park
Route 2, Box 224-M
Troutman, NC 28166
Telephone: (704) 528-6350

Hours of Operation:

November - February	8 a.m. - 6 p.m.
March, October	8 a.m. - 7 p.m.
April, May, September	8 a.m. - 8 p.m.
June - August	8 a.m. - 9 p.m.

Introduction to the Activity Packet for Duke Power State Park

The environmental education learning experience (EELE), "Testing the Waters," was developed to provide environmental education through a series of hands-on activities geared to Duke Power State Park. This activity packet, designed to be implemented in grades 4 - 6, meets curriculum objectives of the standard course of study established by the North Carolina Department of Public Instruction. It includes three types of activities: pre-visit, on-site and post-visit. The on-site activity will be conducted at the park, while pre- and post-visit activities are designed for the classroom. These activities should be performed in a series to build upon students' newly gained knowledge and experiences.

The environmental education learning experience, "Testing the Waters," will acquaint students with the following major concepts:

- **Water quality**
- **Watersheds**
- **Aquatic sampling**
- **Water pollution**
- **Preservation of natural areas**
- **Land use**

Vocabulary words used throughout this environmental education learning experience will appear in **bold type** the first time they are used in each activity. These words and their definitions may be found in the vocabulary list at the back of the activity packet. A list of reference materials used in developing the activities follows the vocabulary list.

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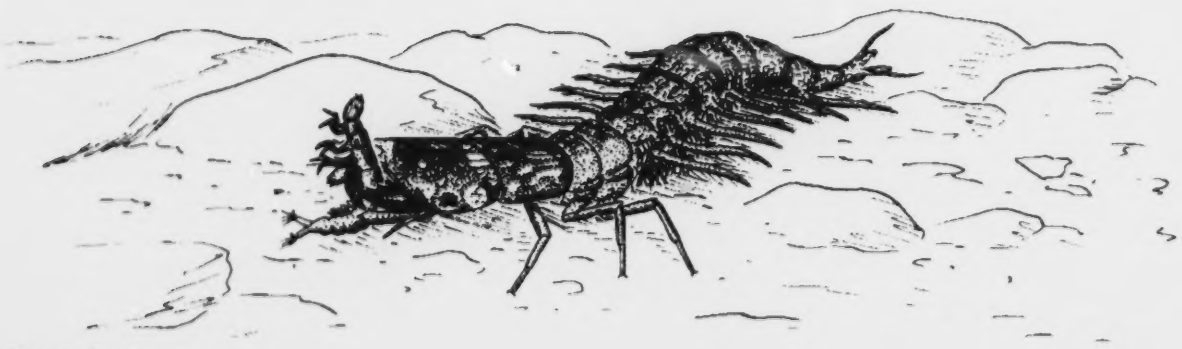
NOTE: The on-site activity may require hiking which could expose the students to hot, humid conditions and poisonous insects, snakes and plants. Accessibility to some of these areas will be difficult for persons with physical handicaps.



Merritt, Cummins, Aquatic Entomology
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Activity Summary

The following outline provides a brief summary of each activity, the major concepts introduced and the objectives met by completion of the activity.

I. Pre-Visit Activities

#1 Key It Out (page 3.1.1)

Students will learn to use a dichotomous key through a series of fun activities. In Part I, students will use a simple key to identify unknown tree leaves. In Part 2, the students will use a more complex key to identify macroinvertebrates found in Lake Norman.

Major Concepts:
- Dichotomous key
- Macroinvertebrate external anatomy
- Taxonomy

Learning Skills:
- Observing, classifying and communicating
- Reading informational materials (scientific keys)

Objectives:
- Give an operational definition of taxonomy.
- List the names of six characteristics that are used to classify different leaves.
- Use a dichotomous key to correctly identify pictures of 10 different leaves.
- List the names of seven characteristics that are used to classify insect species.
- Use a dichotomous key to correctly identify pictures of six insect species.

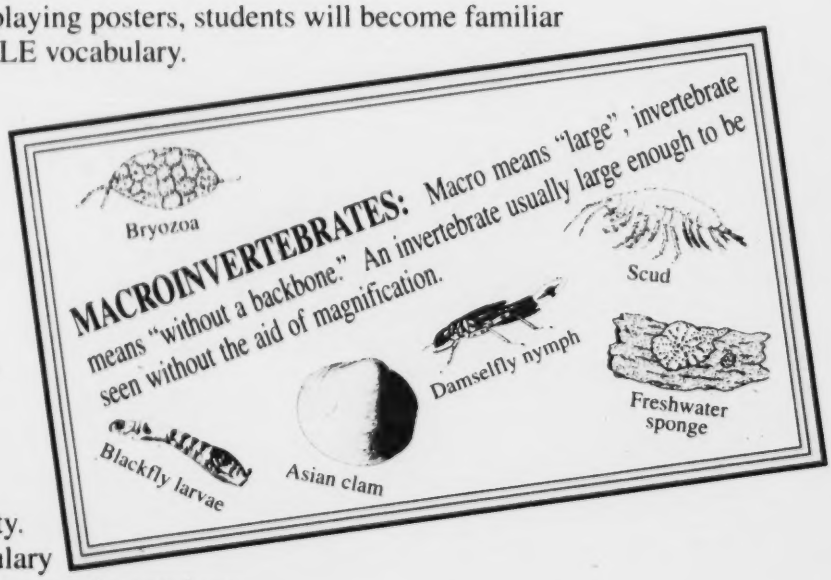
#2 Picture This (page 3.2.1)

By creating, presenting and displaying posters, students will become familiar with water-related words in the EELE vocabulary.

Major Concepts:
- Water
- Water quality
- Watershed

Learning Skills:
- Communicating
- Recognizing key words
- Creating visual representations of concepts

Objectives:
- Define the terms water, watershed, and water quality.
- Illustrate an aquatic vocabulary word and explain its meaning to other students.


Bryozoa
MACROINVERTEBRATES: Macro means "large", invertebrate means "without a backbone." An invertebrate usually large enough to be seen without the aid of magnification.
Scud
Damselfly nymph
Freshwater sponge
Blackfly larvae
Asian clam

#3 River Roots (page 3.3.1)

Students will understand the concept of watersheds and become familiar with the park lake watershed by outlining and identifying the features of the watershed on a topographic map and working in groups to answer questions on a worksheet.

Major Concepts:
- Watersheds
- Topographic maps

Learning Skills:
- Communicating, measuring, inferring, and predicting
- Reading and interpreting topographic maps
- Measuring and estimating
- Working effectively in groups

Objectives:
- Use a legend to identify common symbols on a topographic map such as the symbols for a creek, permanent structure, forested area, and open area.
- Correctly locate specific geographic features on a topographic map such as rivers, mountains, and watersheds.
- Use a map scale to estimate distances on a topographic map, and read contour lines to estimate elevations.
- Draw inferences from a topographic map regarding human activities and their possible effects on specific watersheds.

II. On-Site Activities

#1 Life at the Bottom (page 4.1.1)

Students will use different methods to collect and identify aquatic organisms and make inferences concerning the quality of the water based on their findings.

Major Concepts:
- Water quality
- Indicator species
- Macroinvertebrate external anatomy
- Dichotomous key

Learning Skills:
- Observing, classifying, and communicating
- Interpreting data and making inferences

Objectives:
- Describe three characteristics of an aquatic macroinvertebrate.
- Key out and identify three macroinvertebrates.
- Define indicator species.
- Name three indicator species and explain how they are used to determine water quality.
- Use keys and field guides to identify unknown aquatic specimens.
- List three or more ways humans affect aquatic life.

#2 Water Lab (page 4.2.1)

Students will work in teams to conduct some simple physical and chemical tests (pH, turbidity, and temperature) to determine the quality of a body of water.

Major Concepts:

- Water quality
- Turbidity
- pH
- Temperature

Learning Skills:

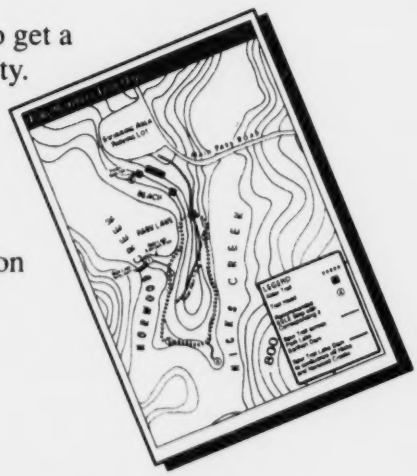
- Observing, communicating, interpreting data
- Measuring
- Reading and interpreting scientific charts

Objectives:

- Name and describe three characteristics of water that contribute to the overall quality of a water sample or body of water.
- Determine the pH, temperature and turbidity of lake water samples and make inferences regarding the overall water quality based on the test results.
- Using the test results and other information, write predictions for the kinds of aquatic life that might live in the lake.

#3 Lake Watchers (page 4.3.1)

Students will take a short nature walk along the lakeshore to get a glimpse at some of the major factors affecting local water quality. Students may also observe and identify aquatic wildlife.



Major Concepts:

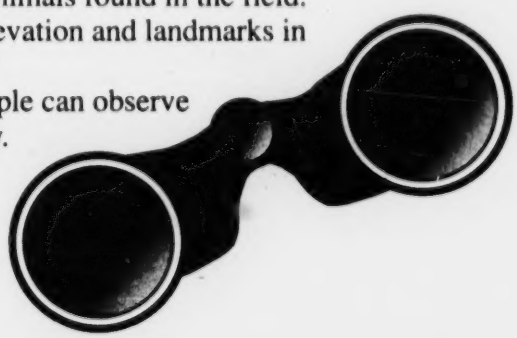
- Water quality
- Recreation
- Runoff
- Urbanization
- Dams
- Water pollution
- Aquatic life
- Turbidity
- Sedimentation

Learning Skills:

- Observing, communicating, inferring
- Collecting, analyzing and evaluating information
- Map reading, taking responsible action

Objectives:

- Describe three positive effects and three negative effects of dams on people and wildlife.
- Describe two ways that people can minimize the negative environmental impacts of dams.
- Identify three examples of aquatic plants and animals found in the field.
- Use a topographic map to identify direction, elevation and landmarks in the field.
- Describe three characteristics of water that people can observe in order to make inferences about water quality.
- Explain how urbanization affects water quality.
- List two negative impacts of recreation on water quality.



III. Post-Visit Activities

#1 Park Lake (page 5.1.1)

Using a map of Park Lake and land use cutouts, students will make decisions about the development of a portion of the Lake Norman area.

Major Concepts:

- Human impact
- Land use issues
- Water quality
- Stewardship

Learning Skills:

- Interpreting data, communicating, evaluating
- Organizing and analyzing information

Objectives:

- Discuss and evaluate the effects of three different land use methods on Park Lake.
- List three ways that people can change their lifestyles to reduce damages to water quality and to Park Lake.
- List three ways businesses, industries, and communities could change to decrease the negative effects they have on the water quality of Park Lake.

#2 Guilty or Innocent (page 5.2.1)

Students will discuss ways water becomes polluted and evaluate the actions of fictitious characters. They will also examine effects of their own actions on the quality of water and learn what they can do to minimize pollution.

Major Concepts:

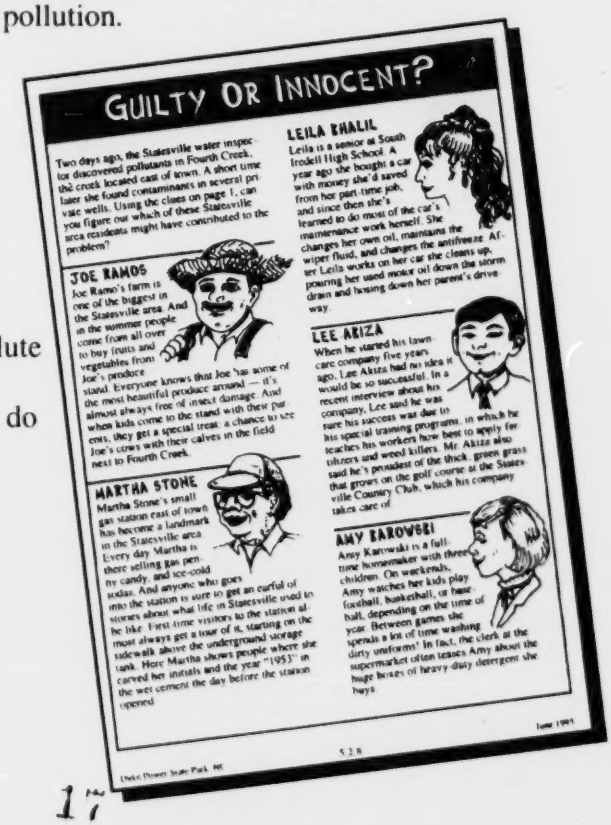
- Water quality
- Environmental ethics

Learning Skills:

- Communicating
- Inferring and elaborating

Objectives:

- Describe at least five ways people pollute water.
- Identify at least five things people can do to help prevent water pollution.


GUILTY OR INNOCENT?

Two days ago, the Statesville water inspector discovered pollutants in Fourth Creek, the creek located east of town. A short time later she found contaminants in several private wells. Using the clues on page 1, can you figure out which of these Statesville area residents might have contributed to the problem?

JOE RAMOS
Joe Ramo's farm is one of the biggest in the Statesville area. And in the summer people come from all over to buy fruits and vegetables from Joe's produce stand. Everyone knows that Joe has some of the most beautiful produce around — it's almost always free of insect damage. And when kids come to the stand with their parents, they get a special treat: a chance to see Joe's cows with their calves in the field next to Fourth Creek.

LEILA KHALIL
Leila is a senior at South Iredell High School. A year ago she bought a car with money she'd saved from her part-time job, and since then she's learned to do most of the car's maintenance work herself. She changes her own oil, maintains the wiper fluid, and changes the antifreeze. After Leila works on her car she cleans up, pouring her used motor oil down the storm drain and hosing down her parent's driveway.

LEE AKIZA
When he started his lawn-care company five years ago, Lee Akiza had no idea it would be so successful. In a recent interview about his company, Lee said he was sure his success was due to his special training programs, in which he teaches his workers how best to apply fertilizers and weed killers. Mr. Akiza also said he's proudest of the thick, green grass that grows on the golf course at the Statesville Country Club, which his company takes care of.

MARTHA STONE
Martha Stone's small gas station east of town has become a landmark in the Statesville area. Every day Martha is there selling gas, penny candy, and ice-cold sodas. And anyone who goes into the station is sure to get an earful of stories about what life in Statesville used to be like. First time visitors to the station almost always get a tour of it, starting on the sidewalk above the underground storage tank. Here Martha shows people where she carved her initials and the year "1953" in the wet cement the day before the station opened.

AMY KAROWSKI
Amy Karowski is a full-time homemaker with three children. On weekends, Amy watches her kids play football, basketball, or base-ball, depending on the time of year. Between games she spends a lot of time washing dirty uniforms! In fact, the clerk at the supermarket often teases Amy about the huge boxes of heavy-duty detergent she buys.

5.2.8

Duke Power State Park, NC

June 1995

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#3 Pollution Dilution (page 5.3.1)

Students will become familiar with the major types of aquatic pollution and predict the potential effects of a variety of aquatic pollutants on wildlife and people.

Major Concepts:

- Water pollution
- Watershed
- Point pollution
- Non-point pollution

Learning Skills:

- Interpreting data, communicating
- Graphing
- Organizing and analyzing information

Objectives:

- List at least four major types of aquatic pollution.
- Given a list of pollutants in a water sample and a description of land use in a watershed, make inferences on the probable causes of the pollution in the sample.
- Predict the potential effects of a variety of aquatic pollutants on wildlife and people.

Correlation Chart

Note to classroom teachers: The following Correlation Chart shows how each activity in this Environmental Education Learning Experience (EELE) correlates with the North Carolina Department of Public Instruction (DPI) objectives in science, mathematics, social studies and English language arts. The activities are listed in the order in which they appear in this EELE. The recommended grade levels are listed along the side of the chart. Notice that only the objective numbers are listed. Use your DPI Teacher Handbook for each subject area to get a complete description of the objectives in that subject area.

Pre-Visit Activity #1: Key It Out, p. 3.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	2.1, 2.2, 2.4, 2.5, 4.1, 4.3, 5.1, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		4.1, measuring
5	2.1, 2.2, 2.4, 2.5, 4.1, 4.3, 5.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		
6	2.1, 2.2, 2.4, 2.5, 4.1, 4.3, 6.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		
7	2.1, 2.2, 2.4, 2.5, 4.1, 4.3, 6.1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		4.1, measuring

Pre-Visit Activity #2: Picture This, p. 3.2.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	2.1, 2.4, 2.10, 4.1, 4.2, 5.1, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		
5	2.1, 2.4, 2.10, 4.1, 4.2, 5.1, 5.3	1.1, 1.2, 1.3 2.1, 2.2, 2.3		
6	2.1, 2.4, 2.10, 4.1, 4.2, 5.1, 6.1, 6.2, 6.3	1.2, 2.1, 2.2, 4.1, 4.3		
7	2.1, 2.4, 2.10, 4.1, 4.2, 5.1, 6.4, 6.8	1.2, 2.1, 2.2, 4.1, 4.3		

Correlation Chart

Pre-Visit Activity #3: River Roots, p. 3.3.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3	3.1, 3.2, 3.3, 4.2, 5.2, 5.3, 9.4, Skill Goals I & II	2.6, 4.1, 4.11, 7.1, 7.2
5	2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 4.1, 4.2, 5.3, 5.4, 5.5	1.1, 1.2, 1.3, 2.1, 2.2, 2.3	2.3, 3.1, 5.2, 5.3, Skill Goals I & II	2.9, 2.10, 4.5, 4.6, 7.1
6	2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 4.1, 4.2, 5.1, 6.3	1.1, 2.1, 2.2, 2.3		2.7, 4.1 4.2, 4.3, 5.4, 7.1
7	2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 4.1, 4.2, 5.1, 6.8	1.1, 2.1, 2.2, 2.3		2.2, 2.4, 4.1, 4.2, 5.1, 5.4, 7.1, 7.4

On-Site Activity #1: Life at the Bottom, p. 4.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	1.3, 1.5, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 5.1, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		5.1, 6.1, 6.2, 6.4, 7.7
5	1.3, 1.5, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 5.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		5.1, 6.2, 7.1
6	1.3, 1.5, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 6.1, 6.2, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		5.1, 5.4, 5.5, 6.6, 7.1, 7.8
7	1.3, 1.5, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3		5.1, 6.4, 7.1, 7.4, 7.5

Correlation Chart

On-Site Activity #2: Water Lab, p. 4.2.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	1.3, 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.3		4.1, 4.11
5	1.3, 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 4.1, 4.2, 5.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.3		4.6
6	1.3, 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 4.1, 4.2, 6.3	1.2, 2.1, 2.2, 2.3		4.2
7	1.3, 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 3.1, 3.3, 3.4, 4.1, 4.2	1.2, 2.1, 2.2, 2.3		4.1, 4.2

On-Site Activity #3: Lake Watchers, p. 4.3.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 4.1, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.2	1.3, 3.1, 3.2, 3.3, 4.2, 5.1, 5.2, 5.3, 6.2, 9.4, 11.1, 11.3, 12.2 Skill Goals I, II & IV	
5	2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 4.1, 4.2, 5.3, 5.4, 5.5	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.2	2.3, 3.1, 3.2, 5.1, 5.2, 5.3, 9.1, 9.2, 11.1, 11.3 Skill Goals I, II & IV	
6	2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 4.1, 4.2, 5.1, 6.3	1.1, 2.1, 2.2, 2.3, 4.2		2.7
7	2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 4.1, 4.2, 5.1, 6.8	1.1, 2.1, 2.2, 2.3, 4.2		

Correlation Chart

Post-Visit Activity #1: Park Lake, p. 5.1.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	1.1, 2.4, 2.6, 2.7, 2.14, 4.1, 4.2, 4.4, 5.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 4.2	2.2, 2.3, 3.2, 3.3, 5.2, 5.3, 7.5, 8.2, 8.3, 9.1, 9.2, 9.4, 10.1, 11.2, Skill Goals I,II,III & IV	
5	1.1, 2.4, 2.6, 2.7, 2.14, 4.1, 4.2, 4.4, 5.3, 5.4, 5.5	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 4.2	2.3, 3.2, 5.1, 5.2, 5.3, 7.3, 8.2, 9.2 Skill Goals I,II,III & IV	
6	1.1, 2.4, 2.6, 2.7, 2.14, 4.1, 4.2, 4.4, 5.1, 6.3	1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 4.2		
7	1.1, 2.4, 2.6, 2.7, 2.14, 4.1, 4.2, 4.4, 5.1, 6.8	1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 4.2		

Post-Visit Activity #2: Guilty or Innocent, p. 5.2.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	2.4, 2.6, 4.2	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.3	5.2, 5.3, 9.4 Skill Goals I,II,III, & IV	
5	2.4, 2.6, 4.2, 5.3, 5.4, 5.5	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.3	2.3, 5.2, 5.3 Skill Goals I,II,III, & IV	
6	2.4, 2.6, 4.2, 5.1, 6.3	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2, 4.3		
7	2.4, 2.6, 4.2, 5.1, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2, 4.3		

Correlation Chart

Post-Visit Activity #3: Pollution Dilution, p. 5.3.1

Grade	Science	English Lang. Arts	Soc. Studies	Mathematics
4	**2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 4.1, 4.2**	**1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.2**	**4.2, 5.2, 5.3, 9.4 Skill Goals I & II**	**6.1, 6.2, 6.4**
5	2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 4.1, 4.2, 5.3, 5.4, 5.5	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.2	5.1, 5.2, 5.3 Skill Goals I & II	6.1, 6.2
6	**2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 4.1, 4.2, 5.1, 6.3**	**1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2**		**6.1, 6.5, 6.6**
7	2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.9, 4.1, 4.2, 5.1, 6.8	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2		6.1, 6.4

Pre-Visit Activity #1 — Key It Out

Curriculum Objectives:

Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension, study skills using environmental sources
- Guidance: group interaction
- Library/Media Skills: work independently and creatively in preparing assignments
- Science: living things–animals, adaptation to environment, interdependence of animals
- Social Studies: gather, organize and analyze information, draw conclusions, participate effectively in groups

Grade 5
- Communication Skills: listening and visual comprehension, study skills
- Science: earth science, environment

Grade 6
- Communication Skills: listening and visual comprehension, study skills
- Science: earth science, environment
- Math: measurement

Special Considerations:
None

Location: Classroom

Group Size:
30 students, class size

Estimated Time:
Part I: 20 - 30 minutes
Part II: 30 - 50 minutes

Appropriate Season: Any

Materials:
Provided by educator:
Per student: "Key it Out" worksheet, "Key to 10 Common Leaves," pencil
Per group "Key to Aquatic Macroinvertebrates of the Catawba River Watershed," "Aquatic Life Illustrations," ruler

Major concepts:

Part I
- Dichotomous key
- How to use a key
- Importance of keys for identification

Part II
- Basic taxonomy

Objectives:

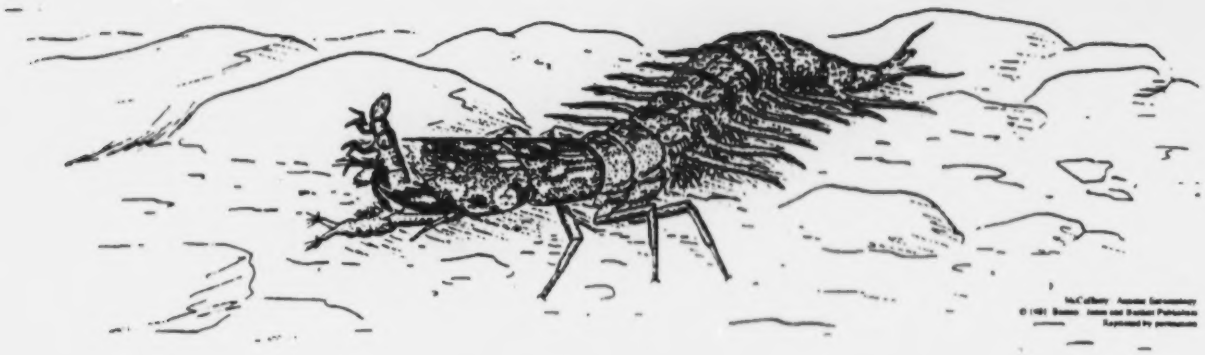
Part I
- Define dichotomous key and explain why it is used.
- Use a simple key to identify five unknown leaves.

Part II
- Define taxonomy.
- Key out at least one macroinvertebrate using a simple key.

Educator's Information:

The purpose of this two-part activity is to introduce the use of a simple dichotomous key. Students will learn what a dichotomous key is, why keys are useful and how to use a simple identification key.

Part I will give students an introduction to the use of a simple key and why keys are useful. In Part 2, the students will be placed into groups and will key out several **macroinvertebrates** using the same key they will use in the on-site activity entitled "Life at the Bottom."



Instructions for Part I:

Have the students read the Student's Information. Discuss taxonomy and how organisms are grouped into naturally related groups. Define a key and discuss why keys are useful. Explain how a key works. Hand out copies of the "Key to 10 Common Leaves" to each student. Have each student work through this key to identify each of the 10 leaves. As a class, go over the answers and discuss any difficulties encountered.

Instructions for Part II:

Divide the students into groups of four or five. Hand each group a copy of "Aquatic Life Illustrations" and a copy of "Key To Common Macroinvertebrates of the Catawba River Watershed." As a class, work through the key to identify animal number 1 then have the students work within their groups to identify the rest of the macroinvertebrates. When the groups are done, have each group share how they identified one of their macroinvertebrates. Discuss the difficulties encountered and reinforce the importance of keys.

Suggested Extensions:

1. Divide class into groups of five or less and hand each group one picture of a macroinvertebrate. Instruct each group to identify their organism and show how they identified it. Rotate pictures until each group has identified all six organisms.

2. Have students create macroinvertebrate "flash cards" to learn identification.

Student's Information:

Taxonomy is the branch of **biology** that classifies **organisms** by established groups. The word, taxonomy comes from the Greek words meaning arrangement and law. Through taxonomy, organisms are placed into related groups based on similarities in morphology (structure and form), **anatomy**, physiology, genetics, **ecology** and **distribution**.

All organisms are grouped into large groups known as Kingdoms. There are five major kingdoms:

1. Animalia (mammals, **insects**, birds, reptiles, etc.)
2. Plantae (plants)
3. Fungi (mushrooms, molds, yeasts, etc.)
4. Protista (some **algae** and protozoans)
5. Monera (bacteria and blue-green algae)

These kingdoms are further divided into more closely related groups. For example, let's trace the taxonomic **classification** of a dragonfly. Dragonflies belong to the Kingdom Animalia. From here, they are divided into the Phylum Arthropoda which contains all insects and their relatives. Next, they are placed in the Class entitled Insecta. In North America alone there are 88,600 Species of insects. The class insecta is further divided into groups called Orders. In North America there are 27 Orders, each Order containing closely related insects. Dragonflies are in the Order Odanata. The next two divisions are Family and **Genus**. The final division is Species. Worldwide there are about 4,500 Species of dragonflies, while in North Carolina there are only 186 Species. If you have a dragonfly and want to know what Species you have, you would use a **key**.

Keys:

A key is an essential tool used by people studying the science of taxonomy. It is defined as an ordered list of significant characteristics of a group of organisms which are used to identify unknown organisms. Simply put, a key is a list of characteristics that describe an organism. Keys are used by scientists and students to identify unknown organisms. Keys often use a combination of pictures and written descriptions to aid in identification. Once you know an organisms name you can look up information about it.

Dichotomous Keys:

Most keys are **dichotomous**, meaning they divide the characteristics that describe an organism into two choices. At each level of the key, you pick the choice that best describes the organism you are trying to identify.

How a Key Works:

Here's how a dichotomous key works. A list of characteristics is arranged as a series of either/or statements. For each pair of statements, choose the one that best describes the item you're identifying. For example, if you were handed a leaf (from a pine tree) to identify, you would start at the top of the key with these two choices:

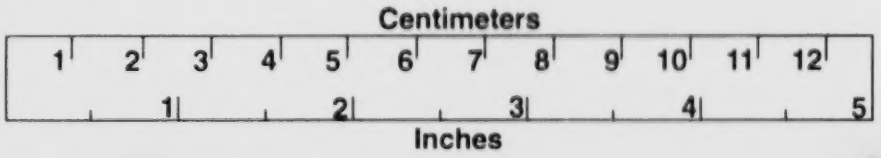
1. Leaves long and needle-like.
2. Leaves not long and needle-like.

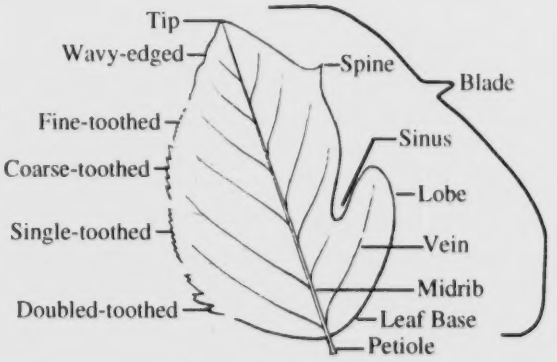
Of course, a pine leaf (or needle) is long and needle-like so you would choose option #1 and continue to the next choice under that side of the dichotomous key.

Key to 10 Common Leaves

(Tree Leaves)

- Leaf long & needle-like
  - Leaves in group of 2; less than 10 cm long — *Shortleaf pine*
  - Leaves in group of 3; more than 10 cm long — *Loblolly pine*
- Leaf not needle-like
  - Leaf with lobes
    - Edge of leaf without teeth
      - Petiole of leaf 1 cm or longer
        - Leaf petiole less than 2 cm — *Sassafras*
        - Leaf petiole longer than 2 cm — *Tulip poplar*
      - Petiole of leaf less than 1 cm — *White oak*
    - Edge of leaf with teeth
      - Leaf with 5 lobes; petiole 3.5 cm or longer — *Sweet gum*
      - Leaf with 3 lobes; petiole shorter than 3.5 cm — *Red maple*
  - Leaf without lobes
    - Leaf edge with teeth
      - Each tooth with spine — *American holly*
      - Teeth without spines — *River birch*
    - Leaf without teeth — *Willow oak*





Duke Power State Park, NC

3144

November 1993

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10 Common Leaves

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

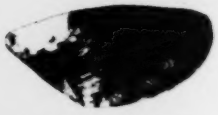
Key to Aquatic Macroinvertebrates

Macroinvertebrates

with shells

double shell

shell attached to submerged objects



*Zebra mussel (T)

shell unattached

shell oblong

Native freshwater mussel (I)

shell triangular

*Asian clam (T)

single shell

obvious legs

three pairs of legs

two pairs of wings

chewing mouth parts, front wings thick (beetles)

hind legs short (swims on surface)

Whirligig beetle Adult (M)

hind legs long

hind legs paddle-like (swims rapidly)

Predaceous diving beetle (M)

hind legs not paddle-like (crawls on submerged objects)

Riffle beetle adult (I)

sucking mouth parts (true bugs)

thin body, long spider-like legs

skates on water surface

Water strider adult (M)

walks on bottom near plants

Water scorpion adult (M)

thick body, up to 3" long

Giant water bug adult (M)

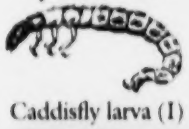
no wings, some undeveloped wing pads

entire body soft except head and thorax

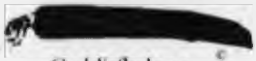
dark brown to black body, prominent pinching jaws

Hellgramite, Dobsonfly (I)

white to greenish body, with or without portable case



Caddisfly larva (I)



Caddisfly larva with case (I)

** Non-native nuisance species. The Zebra mussel is not yet known from North Carolina. It is moving into the southern states. Report its occurrence to Park, Wildlife or Duke Power authorities.*

of the Catawba River Watershed

LEGEND	
Pollution Tolerance	**Index Value**
(I) – Intolerant	**Group 1**
(M) – Moderate	**Group 2**
(T) – Tolerant	**Group 3**

without shells

no obvious legs

more than three pair of legs (crustacea)

small claws on front legs

body flattened side to side

Anphipod scud (M)

body flattened top to bottom

Isopod, Sowbug (M)

large claws on front legs

Crayfish (M)

worm-like

small appendages

no obvious head (lives on submerged leaves and moss)

Cranefly larva (M)

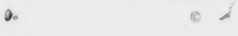
obvious head

rounded abdomen (attached to rocks and sticks, lives in groups)

Black fly larva (T)

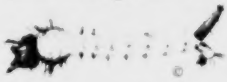
slender abdomen

bright red body (lives on submerged objects)



Chronomid midge (T)

small hairs on body (lives in stagnant water)



Mosquito larva (T)

no appendages

flattened, gray to black color

Leech (T)

cylindrical, red color

Aquatic worm (T)

sponge or jelly-like, grows on submerged objects

usually a flattened pad

Freshwater sponge (M)

ball-like

Bryozoa (M)

entire body exoskeleton hardened, flattened

no obvious tail

Dragonfly nymph (M)

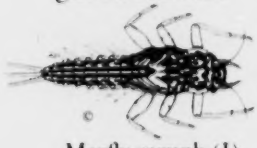
obvious tail

three tails

tails broad, leaf-like

Damselfly nymph (M)

tails slender, gills on abdomen



Mayfly nymph (I)

two tails, no gills on abdomen

Stonefly nymph (I)

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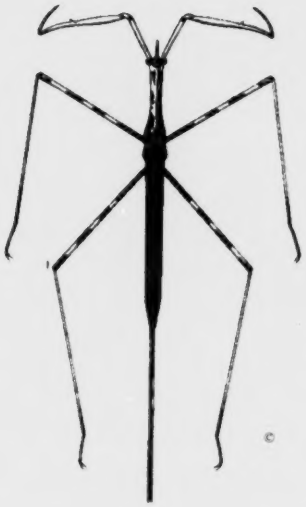
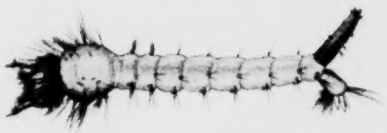
Aquatic Life Illustrations

1. _____



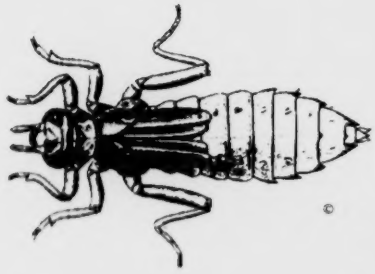
2. _____



3. _____

4. _____

5. _____



6. _____

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Answer Sheet to 10 Common Leaves

1. *Willow oak*

2. *Sassafras*

3. *Sweet gum*

4. *Shortleaf pine*

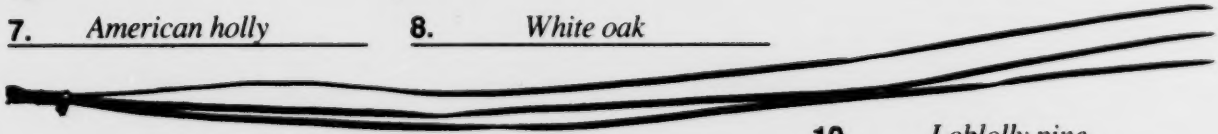
5. *Tulip poplar*

6. *River birch*

7. *American holly*

8. *White oak*

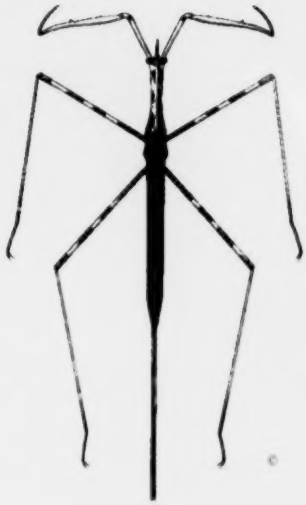
9. *Red maple*



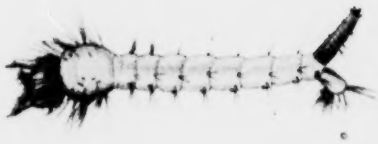
10. *Loblolly pine*

Answer Sheet to Aquatic Life Illustrations

1. *Hellgrammite, Dobsonfly larva*



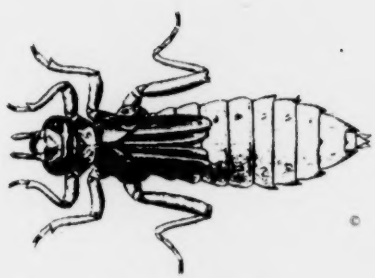
2. *Water scorpion*



3. *Mosquito larva*

4. *Whirligig beetle*

5. *Aquatic worm*



6. *Dragonfly nymph*

McCafferty, Aquatic Entomology
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Pre-Visit Activity #2 — Picture This

Major Concepts:
- Water
- Water quality
- Watershed

Learning Skills:
- Communicating
- Recognizing key words
- Creating visual representations of concepts

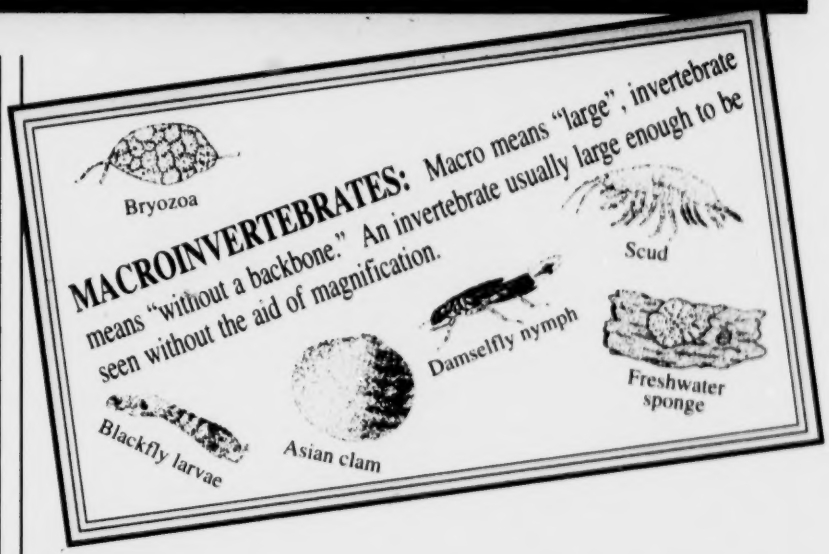
Subject Areas:
- Science
- English Language Arts
- * See the Activity Summary for a Correlation with the DPI objectives in these subject areas.

Location: classroom

Group Size: class size

Time:
1-2 hours for poster creation,
1 hour for presentations

Materials:
Provided by the educator:
Per Class: dictionary; encyclopedia; science textbook; shoebox; assorted environmental/agricultural/travel magazines; assorted colors of markers, crayons, or pencils; assorted colors of construction paper
Per Student: one sheet of posterboard (assorted colors), scissors, paste or glue, sheet of paper, pencil

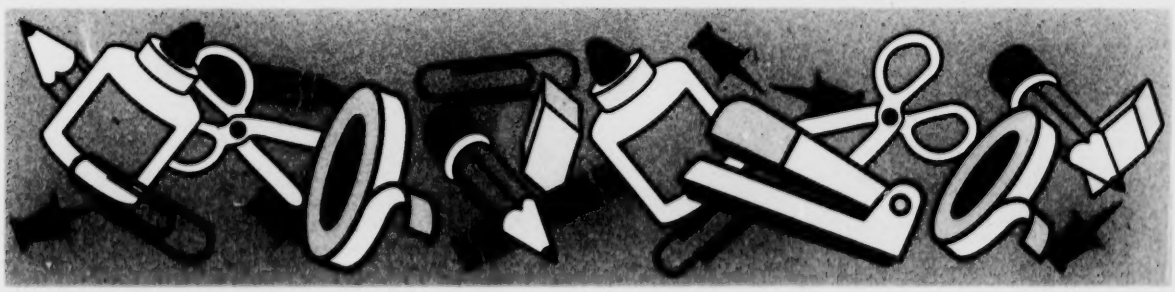

MACROINVERTEBRATES: Macro means "large", invertebrate means "without a backbone." An invertebrate usually large enough to be seen without the aid of magnification.
Bryozoa
Scud
Damselfly nymph
Freshwater sponge
Blackfly larvae
Asian clam

Objectives:

- Define the terms water, watershed, and water quality.
- Illustrate an aquatic vocabulary word and explain its meaning to other students.

Educator's Information:

The purpose of this activity is to familiarize students with as many water-related words as possible. The following words, found in the vocabulary section of the EELE, are especially critical as they will be used during the on-site activities at the park: algae, aquatic index, classification, detritus, dichotomous key, dissolved oxygen, effluent, genus, groundwater, impervious surface, indicator species, larva, macroinvertebrate, metamorphosis, mussel, nymph, pH, runoff, sediment, silt, taxonomy, tributary, wastewater treatment plant, water quality, watershed. The students should not memorize the definitions, but they should know how to use the words correctly in a sentence. The goal is for students to relate these words and concepts to their everyday experiences with water.



Instructions:

1. Write aquatic vocabulary words on separate pieces of paper or index cards. You will need one word for each member of the class. Be sure to use the words listed in the Educator's Information. Add more words, if needed, from the vocabulary section of the EELE.

2. Read and/or discuss the Student's Information with the class. Tell the students that each of them will be receiving a vocabulary word that is related to water. They will be using these vocabulary words during their activities at Duke Power State Park. Their task will be to design a poster that shows how their word is related to water and water quality.

3. Place the words in a shoebox and ask each student to take one word.

4. Instruct students to find a definition for their word using a dictionary, the EELE vocabulary section, science textbook, encyclopedia, or other reference book. They should write their word and its definition somewhere on their poster. They can do their own artwork or use magazine pictures to illustrate how their word is related to water.

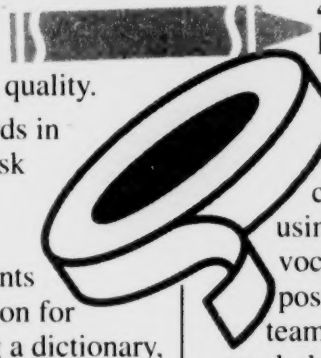
5. Have each student present his/her word to the class by reading the definition and displaying the poster. Turn your classroom and/or hallway into a gallery of water art. The posters will serve as visual reminders of important concepts and will help promote water quality awareness to other students in the school.

Suggested Extensions:

1. Give a vocabulary test.

2. Have a vocabulary contest. Divide class into teams, have one student from each team face off with another to see which team can define the most words the fastest on paper.

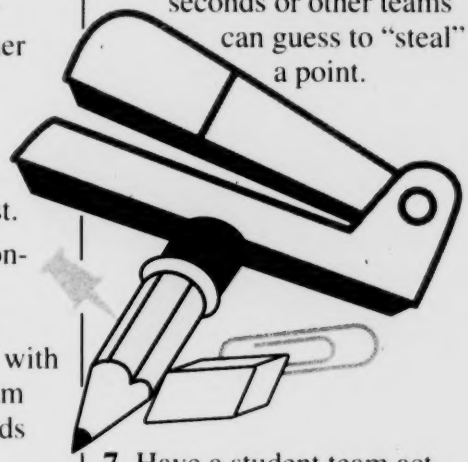
3. Create vocabulary flash cards.



4. Create a vocabulary word search or crossword puzzle.

5. Instruct student teams to create word webs using as many EELE vocabulary words as possible. Provide each team with a copy of the vocabulary section of this EELE. Other related words could be included as well.

6. Divide students into teams. Write all of the vocabulary words in the EELE on separate pieces of paper and place them in the shoebox. Use the words to play "Pictionary" in which one member draws a picture(s) to represent a vocabulary word drawn from the shoebox. Team members must guess the correct word within 30 seconds or other teams can guess to "steal" a point.



7. Have a student team act out a vocabulary word. Other teams watch the skit. After 30 seconds, each team turns in their guess written on a slip of paper. Each team that guesses correctly gets one point. The performing team gets one point if one or more of the other teams guesses the word correctly. If none of the other teams are able to correctly identify the vocabulary word, the performing team does not score a point.

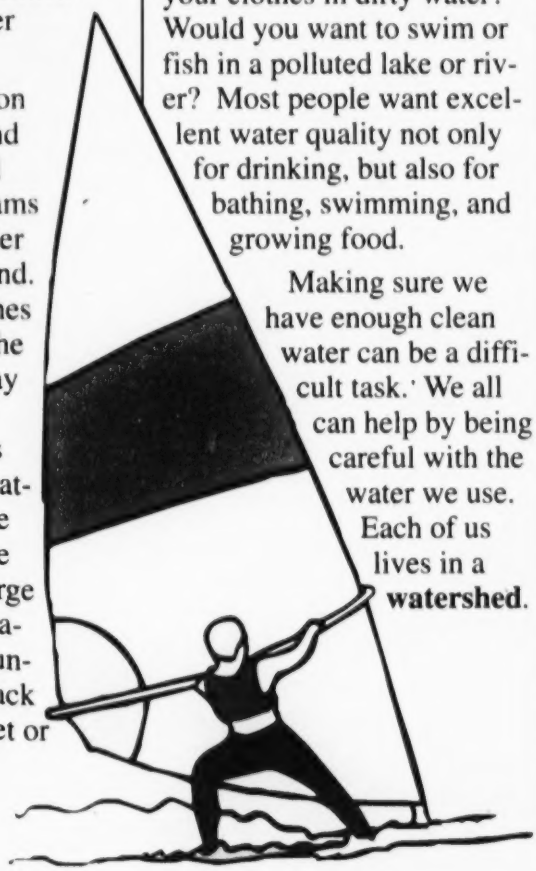
Student's Information

Water is central to all life and life's activities, including reproduction and growth! Plants and animals must have water to survive. Water represents about 75 percent of a person's body weight and covers nearly 75 percent of the earth's surface. Nearly everything on earth can be directly or indirectly traced to a connection with water, or is involved in the water cycle. Even the driest desert contains water. It is easy to see why scientists call Earth the "water planet."

Water is always on the move. Rocks and soil filter water and channel it into streams and rivers both under and above the ground. Ponds, lakes, marshes and swamps slow the water down and may hold it for awhile. But water is always escaping by evaporating from the surface and floating into the air. Clouds carry large amounts of water vapor across the sky until the water falls back to earth as rain, sleet or snow. Even the glaciers, our planet's largest freshwater storage tanks, are constantly moving, melting and changing shape.

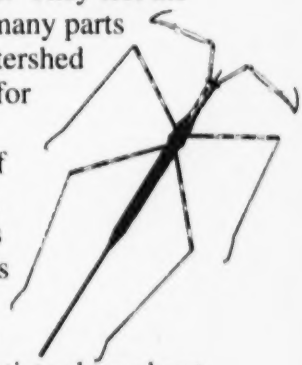
Although water is constantly recycling, this doesn't mean it will always be available for our use. Freshwater may be scarce in some places and abundant in others. Sometimes water becomes polluted or poisoned and is difficult to clean. Care must be taken to protect our water resources, especially the **water quality**. Would you want to take a shower or wash your clothes in dirty water? Would you want to swim or fish in a polluted lake or river? Most people want excellent water quality not only for drinking, but also for bathing, swimming, and growing food.

Making sure we have enough clean water can be a difficult task. We all can help by being careful with the water we use. Each of us lives in a **watershed**.



A watershed is the total land area that drains into a particular river, lake or stream. If we pollute the water in one part of the watershed, the water quality in the rest of the watershed will be affected. Some people use water as a place to dump trash. This not only affects them, but can hurt the other people and the wildlife that live in their watershed.

Scientists manage the water quality of a lake, such as the lake at Duke Power State Park, by studying its watershed. They test the water in many parts of the watershed and look for possible sources of pollution. The kinds of animals living in the water give scientists clues about water quality. Some insects and other **macroinvertebrates** can only live in water that is very clean. If these animals are present, they indicate good water quality. When you visit the park, you will have the opportunity to study the water quality and explore the watershed. You may even find new ways to improve the water quality in the park's watershed.



Pre-Visit Activity #3 — River Roots

Major concepts:
- Watersheds
- Topographic maps

Learning Skills:
- Communicating, measuring, inferring, and predicting
- Reading and interpreting topographic maps
- Measuring and estimating
- Working effectively in groups

Subject Areas:
- Science
- Social Studies
- Mathematics
- English Language Arts

* See the Activity Summary for a Correlation with the DPI objectives in these subject areas.

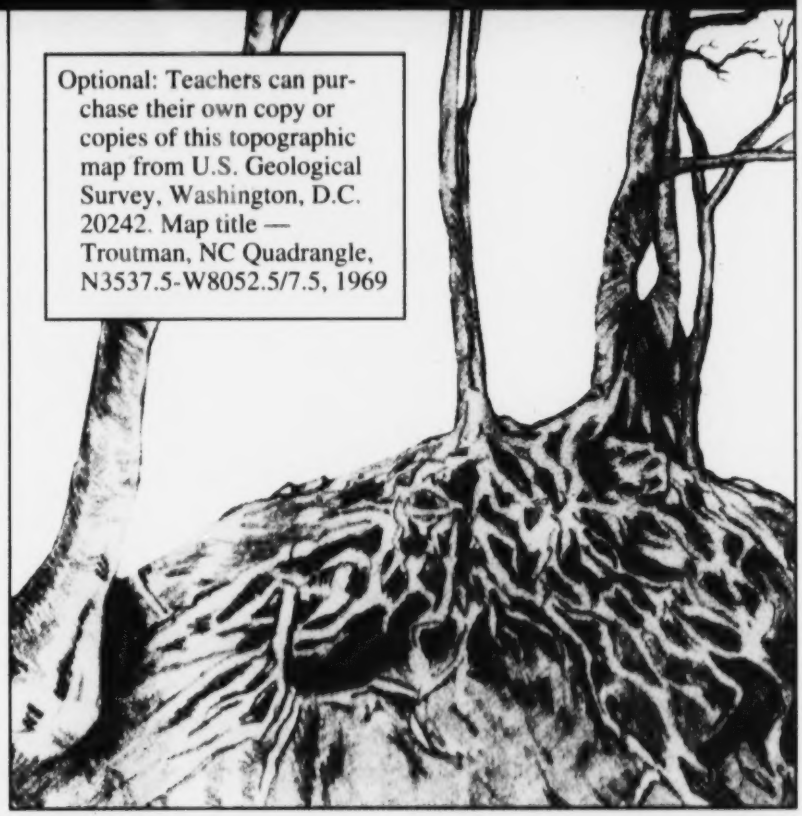
Location: Classroom

Group Size: 30 or smaller in groups of 5 or less

Estimated Time:
1 to 1 1/2 hours

Materials:
Provided by the park upon request:
Per Educator: One USGS Topographic map already colored which will serve as answer key
Per Group: One laminated USGS Topographic map of Troutman, NC Quadrangle; set of overhead projector pens (colors: red, green, blue, and black)
Provided by the educator:
Per Group: ruler and one copy of Enlargement and Supplementary
Per Student: River Roots worksheet; pencil

Optional: Teachers can purchase their own copy or copies of this topographic map from U.S. Geological Survey, Washington, D.C. 20242. Map title — Troutman, NC Quadrangle, N3537.5-W8052.5/7.5, 1969



Objectives:

- Use a legend to identify common symbols on a topographic map such as the symbols for a creek, permanent structure, forested area, and open area.
- Correctly locate specific geographic features on a topographic map such as rivers, mountains, and watersheds.
- Use a map scale to estimate distances on a topographic map, and read contour lines to estimate elevations.
- Draw inferences from a topographic map regarding human activities and their possible effects on specific watersheds.

Educator's Information:

This activity is designed to help students understand the concept of watersheds and to become familiar with the park lake watershed. Using a topographic map, students will outline the watershed; identify creeks, roads, and structures within it; and answer various questions concerning possible influences on the park lake's water quality. Students will participate in groups to complete the worksheet.

Be sure to familiarize students with the EELE vocabulary before doing this activity. One effective means of doing this is to use Pre-Visit Activity #2 — Picture This.

Instructions:

1. Distribute one copy of the Student's Information to each student. Read and discuss this information. Make sure students understand the vocabulary words in bold print.

2. Guided Practice: Divide students into groups of five students or less. Give each group one copy of the Enlargement (a section of a topographic map). Use the Enlargement to show the students how to identify watersheds and other geographic features on a topo map.

3. Pass out the topographic map of the Troutman Quadrangle and the Supplementary. Point out the map legend and north arrow. Use the Supplementary to teach the students about other symbols commonly used on topographic maps. You may also wish to show students how to estimate distances using the map scale, how to estimate elevation by reading contour lines, and how to calculate the area of a triangle. (Pass out the rulers at this time if you are doing a measuring practice, otherwise wait until step 4, below.)

4. Distribute a ruler, a set of overhead projector pens, and the River Roots worksheets to each group. Each student should do one of the instructions under part A of the worksheet. Caution students to use only the projector pens provided when working on the laminated topographic map. Permanent ink will ruin the maps. They should use their own pencils when answering questions on the worksheet. We recommend that the students work together on part B, but that each student fill out his/her own copy of the worksheet.

5. Review the worksheet answers with the students. Discuss the following questions as a class:

A. What are some of the ways people are using the water in the park lake watershed? (Answers: recreation, diluting wastewater, irrigation for crops and water source for livestock, domestic uses).

B. As rain, snow, and other precipitation fall on the park lake watershed, what do they come in contact with? (Answers: Forests, fields, roofs, roads, parking lots, lawns, etc.)

C. What types of pollutants might the precipitation pick up as a result of these contacts? (Answers: fertilizers, silt, animal wastes, etc. from fields and lawns; petroleum products like oils, tar, gas, and automotive fluids from roofs, roads, and parking lots; etc.)

D. Identify less obvious ways the watershed community might pollute the waters. (Answers: overflowing sewage systems; continuous disturbance of soils due to construction, agriculture, logging, etc., leading to increased silt.)

E. How can the watershed community protect the waters? (Answers: farmers could use erosion control methods such as silt fences, terraces, and catchment basin ponds, as well as reduce use of fertilizers and pesticides; homeowners could reduce use of fertilizers and pesticides on lawns and gardens and maintain cars and sewer systems properly; landowners could maintain forests and/or stabilize soils by other methods; etc.)

5. Enlist student help to remove the pen marks from the topographic maps. Use only water and a damp sponge or soft cloth. Return the maps to the park within two weeks.

Suggested Extensions:

1. Conduct this same activity for your school's watershed or for the one that each student lives in; or for a watershed in another country. Compare watersheds in terms of the natural and human communities, possible sources of pollution, and the geology of the watersheds. Comparing watersheds from different countries or regions can be quite interesting.

2. Have students create posters illustrating the effects of watershed pollution. They should show how pollutants in one part of the watershed can migrate to other parts, and even to different watersheds.

3. Using maps of the Catawba River Basin, have students trace the flow of water from its headwaters to the South Carolina state line. These maps are available from: Stream Watch Coordinator, Division of Water Resources, EHNR, P.O. Box 27687, Raleigh, NC 27611, (919) 733-4064. Order the Upper and Lower Basin maps.

Student's Information:

Each of us lives in a **watershed.** One way to picture a watershed is to think of a mountain valley. Imagine you are standing at the bottom of the valley, near a river. Looking up, you can see high ridges all around you. These ridges are the boundaries of the watershed. Since water always seeks the lowest level, all the precipitation that falls on the ridges and slopes will eventually end up in the river at the bottom of the valley. All the land between the high ridges and the bottom of the valley is part of this watershed. Activities that occur anywhere in the watershed will affect the river's water quality.

In the piedmont and coastal plain, the land slopes more gradually to a river or lake. Although the watersheds aren't as obvious as those in the mountains, they do exist. One way to picture a watershed in the piedmont is to look at a map. Find a river and its tributaries. If you think of the river as a giant tree and the tributaries as the tree's roots, all the land surrounding the "roots" is a part of this watershed. Whatever happens in the river's roots affects the entire river. The large watershed of a river is often referred to as a **river basin.**

Watersheds are naturally self-destructive. The creeks or rivers that shape the watershed gradually erode the land. Human actions such as land clearing, dam building, farming, water diversion, and industrial development can speed up this natural process. If not carefully done, these activities can loosen the soil, allowing excessive amounts of sediment to run into the creeks and tributaries of the watershed. The sediments fill stream channels and harbors, and suffocate fish and other aquatic animals by clogging their gills.

People can harm a watershed in other ways. When it rains, fertilizers (sometimes called nutrients) run off farm fields and lawns into the water. They can also enter the watershed from wastewater treatment plants and septic systems. The fertilizers cause large amounts of **algae** to grow, creating an **algae bloom**. The algae die after they have used all the nutrients. As bacteria decompose the dead algae, they use up the oxygen in the water that fish and other aquatic animals need to breathe. A fish kill may result. Fertilizer can also cause aquatic weeds to grow, clogging streams and ponds. This deadly process, known as **eutrophication**, greatly reduces the water quality in the watershed.

Other pollutants such as chemicals from industry, pesticides used in agriculture, and motor oil from cars can cause problems in a watershed. Many chemicals are poisonous to wildlife and people. Aquatic animals are especially vulnerable. Chemicals in one part of a watershed can work their way to other parts. One serious **pollution** event can damage aquatic **food chains** in the watershed for many years.

It is important to realize that although we can study individual watersheds, the watersheds are actually connected to one another. For example, a river basin contains the smaller watersheds of all the river's tributaries. If one of these smaller watersheds becomes contaminated, it will eventually affect the watersheds downstream. As water flows downstream to the ocean, contaminants can accumulate and cause great damage to the lower part of the river basin.

In this activity, you will use a topographic map to study the park lake watershed. This small watershed connects with the larger watershed of Lake Norman which in turn is part of the Catawba River Basin. You will look at human activities in the park lake watershed and possible sources of pollution. When you visit Duke Power State Park, you will be able to explore the watershed firsthand.

River Roots Worksheet

Name:_____

A. Exercises: Use only the projector pens provided.

1. Locate Duke Power State Park and trace its boundary with the green pen.
2. Locate the park lake and outline with the blue pen. (Note: the park lake is part of the Norwood Creek watershed and is separated from Lake Norman by an earthen dam.)
3. Trace all of the creeks, branches, and tributaries that empty into the park lake with the blue pen.
4. Trace the boundary of the park lake watershed with the red pen using the nearest roads as a general outline.
5. Trace all roads within the watershed with the black pen.
6. Identify all structures within the watershed by circling them with the black pen.

B. Questions

1. Duke Power State Park is located near what town?

   _____

2. In what county is the park located?

   _____

3. What is the only neighboring county listed on the map?

   _____

4. Count all of the named creeks and branches that empty into the park lake. How many are there? List the names.

   _____

   _____

5. Using the scale at the bottom of the map, estimate the length of each of these named creeks and branches in miles. Also add them together for a total.

   _____

   _____

6. In addition to these larger creeks/branches, a number of unnamed streams and branches feed the park lake. Approximately how many?

   _____

7. Knowing that the watershed is in the shape of a triangle (roughly), determine its approximate area in square miles by using the following formula:

   Area of a triangle = 1/2 base x height

   _____

8. Is most of the watershed forests or fields?

9. Besides the park, what large educational facility lies within the watershed?

10. Approximately how many structures/buildings lie within the watershed?

11. Using the scale and road classification key at the bottom of the map, estimate how many miles of light-duty roads lie within the watershed.

12. Into what large body of water does the park lake's water flow?

13. Before the park lake's water reaches the main body of Lake Norman, into what portion of the lake does it empty?

14. What river was dammed to form Lake Norman?

15. In what compass direction do most of the park lake's tributaries flow?

16. Calculate the change in elevation from park lake to the highest point in the watershed.

17. Name some possible sources of pollution in the park lake watershed. Then describe the type(s) of pollutant that each source might contribute.

SOURCE	LIST/DESCRIBE THE WATER POLLUTION
ex: road	*oil and other chemicals from cars*

River Roots Worksheet (Answers)

A. Answers to Exercises:

1. Locate Duke Power State Park and trace its boundary in green.
2. Locate the park lake and outline with the blue pen. (Note: the park lake is part of the Norwood Creek watershed and is separated from Lake Norman by an earthen dam.)
3. Trace all of the creeks, branches, and tributaries that empty into the park lake with the blue pen.
4. Trace the boundary of the park lake watershed with the red pen using the nearest roads as a general outline.
5. Trace all roads within the watershed with the black pen.
6. Identify all structures within the watershed by circling them with black.

(See Topographic Map for answers to Exercises 1-6)

B. Answers to the Questions:

1. Duke Power State Park is located near what town?
   Troutman, NC

2. In what county is the park located?
   Iredell

3. What is the only neighboring county listed on the map?
   Catawba

4. Count all of the named creeks and branches that empty into the park lake. How many are there? **Three**. List the names.
   Norwood Creek, Bass Creek, Powder Spring Branch

5. Using the scale at the bottom of the map, estimate the length of each of these named creeks and branches in miles. Also add them together for a total.
   Norwood Creek: 4 miles, Powder Spring Branch: 3 miles, Bass Creek: 1 mile
   Total: 8 miles

6. In addition to these larger creeks/branches, a number of unnamed streams feed the park lake. Approximately how many?
   25

7. Knowing that the watershed is in the shape of a triangle, determine its approximate area in square miles by using the following formula:

   Area of a triangle = 1/2 base x height

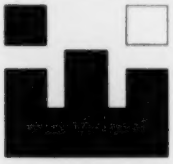
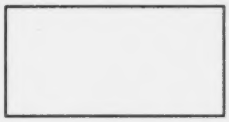
   Area of watershed = $\frac{4 \text{ miles}}{2}$ x 5 miles = approx. 10 sq. miles

8. Is most of the watershed forests or fields?
   Approximately equal
9. Besides the park, what large educational facility lies within the watershed?
   South Iredell High School
10. Approximately how many structures/buildings lie within the watershed?
    200
11. Using the scale and road classification key at the bottom of the map, estimate how many miles of light-duty road lie within the watershed.
    18
12. Into what large body of water does the park lake's water flow?
    Lake Norman
13. Before this water reaches the main body of Lake Norman, into what portion of the lake does it empty?
    Hicks Creek
14. What river was dammed to form Lake Norman?
    The Catawba
15. In what compass direction do most of the park lake's tributaries flow?
    South
16. Calculate the change in elevation from park lake to the highest point in the watershed.
    See the intersection of SR 1333 and SR 1004:
    973 ft. - 760 ft. = 213 ft. change in elevation
17. Name some possible sources of pollution in the park lake watershed. Then describe the type(s) of pollutants that each source might contribute.

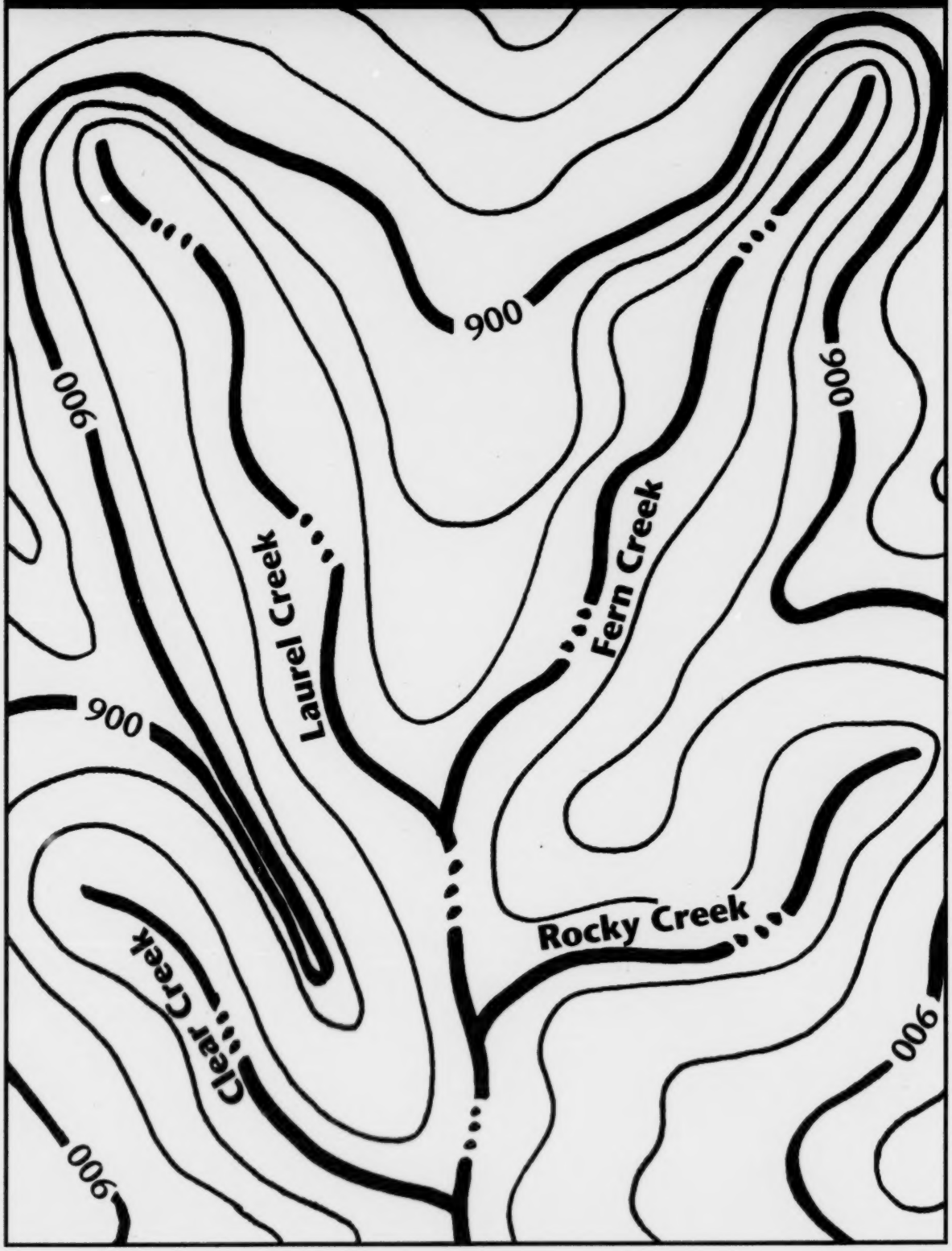
SOURCE	LIST/DESCRIBE THE WATER POLLUTION
ex: road	*oil and other chemicals from cars*
homes	***treated sewage***
gas stations	***gasoline from leaky storage tanks***
logging operations	***runoff — sediment***
boaters and picnickers	***litter***
housing developments	***runoff — sediment, fertilizers, pesticides***
farms	***fertilizers, animal waste, pesticides, herbicides***
industry	***chemicals, dyes***

Supplementary USGS Topographical Map

Symbols and Legends

Symbol(s)	Description
	Type of permanent structure
	Stream, creek, or other flowing water
GREEN AREA	Forested Area
	Open Area (i.e. fields, lawns, etc.)
	Park Boundary

Topo Enlargement



On-Site Activity #1 — Life at the Bottom

Curriculum Objectives:

Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: group interaction
- Healthful Living: recreational safety
- Mathematics: measurement
- Science: living things–animals, adaptation to environment, interdependence of animals
- Social Studies: gather, organize and analyze information; draw conclusions, participate effectively in groups

Grade 5
- Communication Skills: listening and visual comprehension
- Guidance: group interaction
- Healthful Living: recreational safety
- Math: measurement
- Science: earth science, environment
- Social Science: organize and analyze information, draw conclusions, participate effectively in groups

Grade 6
- Communication Skills: listening and visual comprehension
- Guidance: group interaction
- Healthful Living: environmental health, recreational safety
- Math: measurement
- Science: ecology
- Social Science: organize and analyze information; draw conclusions; participate effectively in groups

Location:
Rental boat dock at Park Lake

Group Size:
30 or fewer in groups of 5 or less

Estimated Time:
1 - 1 1/2 hours

Appropriate Season:
Spring, summer, fall

Credits:
Adapted from "A Field Manual for Water Quality Monitoring, an Environmental Education Program for Schools" by Mark K. Mitchell and William B. Stapp.

Materials:
Provided by educator:
Per student: pencil, clipboard, "Aquatic Sampling" worksheet, "Key to Aquatic Macroinvertebrates of the Catawba River Watershed," "Pollution Tolerance of Macroinvertebrates"
Provided by park:
Per student: life jackets
Per group: bottom sampling device, kick net, seine net, dip net, plastic cups, aquarium or white tray, dissecting scope, magnifying glass, tweezers or plastic spoons, field guides, table, laminated "Aquatic Macroinvertebrate Key," rubber gloves, extra activity sheets, examples of adult macroinvertebrates

Special Considerations:
Carry rescue throw rope. All students will wear life jackets during this activity. Students should wear gloves when sorting samples. Handle organisms carefully so that they are not harmed and return them to the water after the activity. Before the activity, advise students of appropriate dress (i.e. old shoes without holes in them, old jeans, etc.) Make sure participants bring a complete change of clothes.

Major Concepts:
- Water quality
- Aquatic sampling
- Indicator species
- Aquatic habitats
- Basic anatomy
- Species identification
- Human influence on water quality

Objectives:
- Describe three characteristics of an aquatic macroinvertebrate.
- Key out three macroinvertebrates.
- Define indicator species.
- Name three indicator species and explain how they are used to determine water quality.
- Use keys and field guides to identify unknown aquatic specimens.
- List three or more ways humans affect aquatic life.

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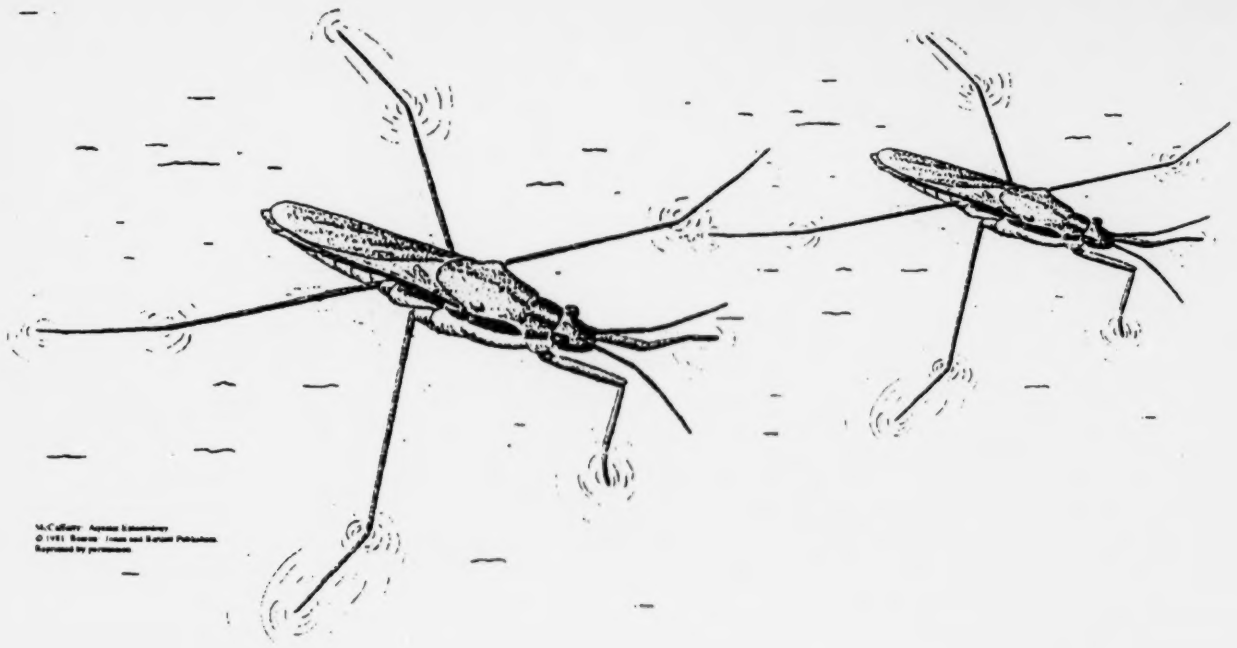


Educator's Information:

In ponds and other aquatic environments the presence or absence of certain organisms, called indicator species, reveals much about the quality of the water. These creatures comprise an aquatic index. That is, their absence or presence tells us something about water quality.

Water with a rich and varied range of aquatic creatures is usually a healthy environment, whereas water with just a few species usually indicates less healthy conditions. "Healthy" is used here to mean an environment supportive of life. Pollution generally reduces the quality of the environment and in turn the diversity of life forms. In some cases the actual biomass or amount of living material will increase due to pollution, but the diversity inevitably goes down.

The major purpose of this activity is for students to be able to recognize indicators of water quality in Park Lake and other aquatic habitats.

The students will be involved in collecting macroinvertebrates in the lake and must be dressed appropriately. Life jackets must be worn at all times. A first aid kit will be available.

Park staff will discuss safety considerations and the educator will assist in seeing that all safety precautions are followed. The students will work in groups of four or five, with one person recording the data. After completing the worksheet, students will gather and discuss their results with the park staff.

Have the students read the Student's Information and complete Pre-Visit Activity – "Key It Out." Discuss these topics as a class prior to your visit.

Student's Information:

"*Water, Water everywhere nor any drop to drink.*" So says the sailor in Samuel Taylor Coleridge's "Rime of the Ancient Mariner" as their boat is becalmed at sea. Fortunately, in our area **water** is everywhere and there seems to be plenty to drink. But that may be changing as Lake Norman becomes more developed and is used by more people. Lets take a closer look at water and discover what a fragile and sensitive resource it is.

What is water? The dictionary defines water as a colorless, odorless transparent liquid occurring on earth as rivers, lakes, oceans, etc., and falling from the clouds as rain, snow, ice, etc. Water occupies more than 70 percent of the earth's surface, and it makes up approximately 60 percent of the human body. You may have heard the saying "Water is life." Think about it for a minute. Can you think of any living **organism** that does not depend on water?

David Quammen, in his book, *Natural Acts, A Sidelong View of Science and Nature* says, "Without life, there would still be water. Without water no life."

Recipe for a Lake

Water comes in many forms. To really appreciate it you need to pick out one of its many forms and get to know it personally. For your visit to Duke Power State Park you need to know more about water in the form of a lake.

What is a lake? A lake is defined as a large, inland body of fresh or salt water. Lake Norman is the largest of a series of man-made reservoirs located along the Catawba River. The river is the result of springs, streams and creeks joining together to produce a larger **volume** of flow. These smaller bodies of water are called **tributaries**. The land that a river and its tributaries flow through is called a **watershed**. A healthy river must have a well protected watershed because any kind of disturbance to the watershed has an effect on the river and the lake into which it flows.

Life in a Lake

The various forms of life found in a lake can be compared to a fine stew or soup. Just like a lake, a fine stew or soup needs lots of different ingredients. Usually the more you add, the better the stew. A stew also needs small amounts of spices to make it taste just right. If you try to make a stew with just one ingredient, or if you leave out an important spice, your stew is not going to be good.

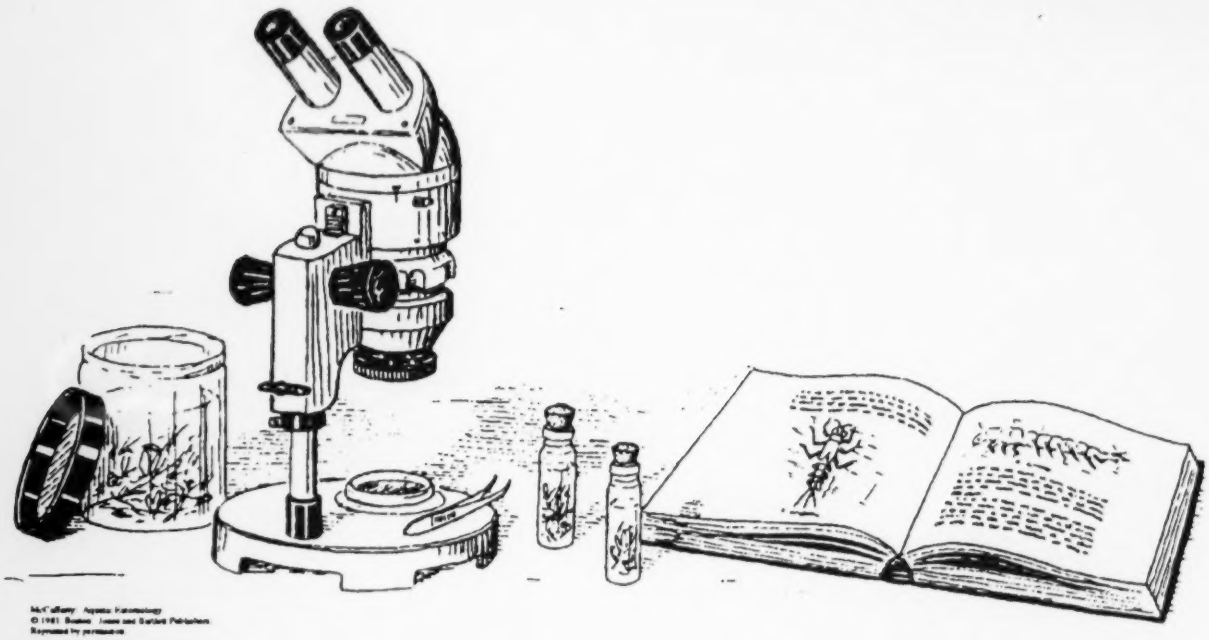
Here then is a recipe for a fine, healthy lake.

Some sunlight – just enough for **algae**, moss, diatoms and **aquatic** plants to **photosynthesize**. (Too much sun heats up the water and robs it of **dissolved oxygen**.)

Dissolved oxygen and carbon dioxide – all the animals in the lake need dissolved oxygen to breathe. These same animals breathe out carbon dioxide which is essential for algae and other aquatic plants. These plants in turn take in the carbon dioxide and give off oxygen.

Fallen leaves – they provide the main source of energy for a river system and thus for a lake as well. In the fall, leaves drift down from the trees into the water where they soon sink to the bottom or get caught in logjams or wedged between rocks. At this point, bacteria and fungi climb aboard the leaves and begin to "munch out," causing the leaves to decompose and break down into smaller pieces. The half-eaten leaves, bacteria and fungi are eventually swept downstream where they provide food for munchers, grazers and filter feeders – the wonderfully adapted **macroinvertebrates** (macros), such as stonefly **nymphs**, mayfly nymphs, and caddisfly **larvae**. These organisms further break down the leaves into a very fine mulch called **detritus**.

In addition to the munchers, grazers and filter feeders, there are other types of macroinvertebrates that prey on other macroinvertebrates. Lots of



different kinds of macros are a sign of a healthy lake or river.

Aquatic plants and animals – aquatic plants provide cover for macros and small minnows. All the aquatic animals in the lake provide food for each other and non-aquatic animals in a complex **food web**. When all these various plants and animals die or excrete waste, they return essential nutrients that were borrowed so that they could live.

Various minerals – the fine spices of a lake include calcium bicarbonate, potassium, nitrates and phosphates. These ingredients help balance a lake's **pH**, provide building material for the shells of snails, **mussels**, clams and crayfish, help fish breathe more efficiently and act as natural fertilizers essential for aquatic plants.

These are just the minimum ingredients needed for a healthy lake or river. Now mind you, a lake or river needs only natural ingredients; unnatural ingredients can have a bad effect. David Quammen sums up what makes a healthy lake or river when he talks about a trout stream. "A good trout stream must first be an excellent **insect** stream, a superior haven for algae and fungi and bacteria, a prime dumping ground for dead leaves, a surpassing reservoir of oxygen and calcium. It will then also, and thereby, be a good osprey stream, a favorite among otters, a salvation to dippers and kingfishers and bank swallows and heron, mergansers and Canada geese and water shrews, mink and muskrat and beaver. Not to mention the occasional grizzly bear. And who knows but that, sometime, a human might want to drink."

If there are plentiful numbers of many different **species** of plants and animals in a lake, then we have a healthy lake. Taking samples of these aquatic plants and animals is a means to monitor the quality of a lake's waters.

Instructions:

1. Park staff will lead a brief discussion focusing on: macroinvertebrates (macros), what they are and why they are important; **metamorphosis**, what it is and how it is accomplished; and **indicator species**, what they are and how they are used to determine the health of a lake. Park staff will also cover how to use sampling equipment and safety precautions that must be followed when using the equipment.

2. Have the students fill in Part A of their worksheet and complete their predictions for Park Lake's **aquatic index**.

3. Briefly review the macroinvertebrate **key**. Be sure to point out that the key is not complete and that the students should therefore key organisms as close as possible. For example, there are 186 dragonfly species in North Carolina. The key shows just one dragonfly larva species but the illustration should be close enough that the students should be successful at identifying any dragonfly larva they find.

4. Demonstrate the technique of collecting bottom samples.

a. Neatly coil the rope and tie the end to the dock.

b. Throw the attached bucket as far as possible out over the lake.

c. Allow the bucket to sink to the lake's bottom.

d. Slowly pull the bucket along the bottom for a few yards then quickly pull it to the surface.

5. Demonstrate the techniques of sample analysis.

a. Fill an aquarium or white tray half way with water.

b. Allow the excess water to drain from the bucket.

c. Put on rubber gloves and pick up some of the mud sample.

d. Spread the sample out evenly on the seine. Keep the seine net at least one inch off the ground whenever there is a sample in it.

e. Carefully pour water over the sample using a plastic cup to wash away **silt**/debris.

f. Search for organisms. (You may have to use magnifying glasses.)

g. Using tweezers or plastic spoons, carefully remove the organisms and place in the aquarium or white tray that is filled halfway with water.

h. Place the aquarium or white tray on the table for observation/identification, using the field guides, laminated invertebrate key and the examples of adult macroinvertebrates.

i. Complete the worksheet.

j. Return all organisms to the water after completing the research.

6. Demonstrate the use of dip, seine and kick nets.

7. Divide the class into groups of five or less, have them pick up their equipment and instruct them to collect samples. As soon as the samples are collected, have the groups move to the shore to complete their worksheets. Remind the students to return the organisms to the water after the animals have been identified.

8. After collecting samples, each group should identify the aquatic macroinvertebrates using the "Key to Aquatic Macroinvertebrates of the Catawba River Watershed." They should also use field guides and dissecting scopes to aid in identification. Have them record their answers on the "Aquatic Sampling Data Sheet" and use their results to determine the Aquatic Index Value (relative health) of the lake.

The Aquatic Index Value groups macros into three categories based on how tolerant or sensitive they are to changes in **water quality**.

Group I includes macros that are very intolerant to water **pollution**. The dominant presence of Group I species is an indication of good water quality. Group I is given an index value of 3.

Group II includes macros that are moderately tolerant to a reduction in water quality. They are given an index value of 2.

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Group III represents macros that are tolerant to pollution. Their dominance indicates poor water quality. They are given an index value of 1. The students will learn how to calculate the Aquatic Index Value by using a simple formula:

(3 x number of Group I)
(2 x number of Group II)
+ (1 x number of Group III)

= Aquatic Index Value

9. After the students have identified their specimens and determined the Aquatic Index Value, park staff will lead a group discussion summarizing what they've learned, what they've identified from the lake, and the importance of indicator species and the Aquatic Index Value.

10. Instruct the groups to gather their equipment, clean it and return it to where they found it.

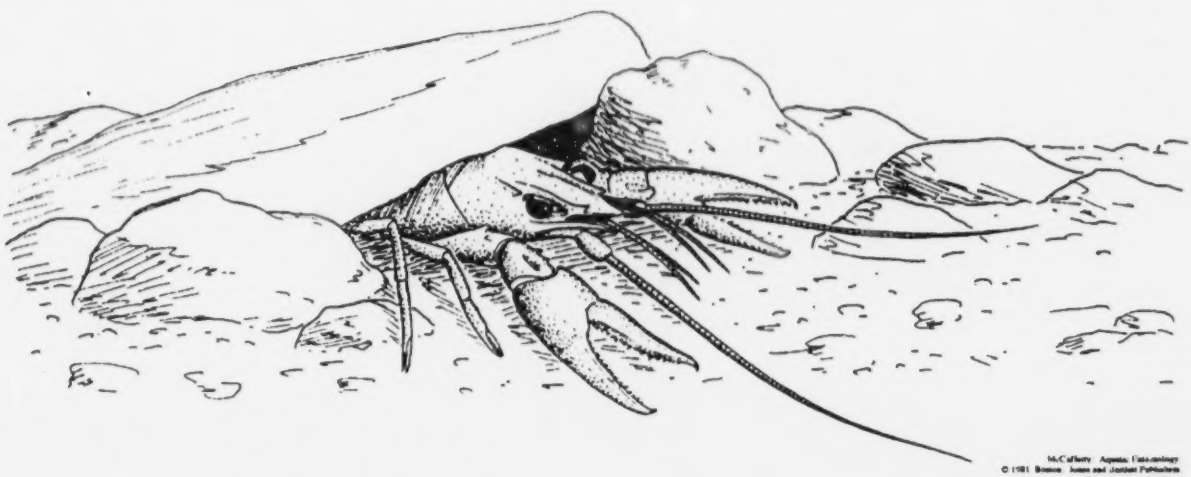
11. Gather the whole class and have each group present their findings. According to their study, what is the rating of the park lake's water quality? How does it compare to the students' initial prediction? If different, encourage students to explore reasons. Do different groups have different results? If so, explore reasons why. (Answers: improper collection/ identification techniques by some; weather; drastic changes in watershed within recent time; etc.)

Suggested extensions:

1. Sample Lake Norman's bottom **sediments** and compare the results to those from the Park Lake.

2. Sample different locations on Park Lake (i.e. below the park lake bridge, near the mouth of the creek, etc.) and compare and contrast results.

3. Sample stream beds of different streams feeding the park lake and compare and contrast results.



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Aquatic Sampling Worksheet

Name: _____ Date: _____

Location: _____

Methods used to sample: _____ Aquatic Index Value: _____

A. Prediction of Park Lake's Aquatic Index: Excellent Good Fair Poor
Circle your choice. Why do you think Park Lake will have this Aquatic Index?

_____

_____

B. Instructions:

1. Use the "Key to Aquatic Macroinvertebrates" or "Pollution Tolerance of Macroinvertebrates" chart to identify organisms.
2. Record the species of organisms found in the space below, using the chart to classify them by their tolerance levels. (See example below.)

Group I	**Group II**	**Group III**
1.	1.	1.
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.
6.	6.	6.
7.	7.	7.
Total =	Total =	Total =

3. Calculate the Aquatic Index Value by multiplying the number of species of organisms in each group by the index value for that group. Then, add the resulting three numbers to obtain the Aquatic Index Value (see example below).

(3 x no. of species - Group I)
(2 x no. of species - Group II)
+ (1 x no. of species - Group III)
= **Aquatic Index Value**

Cumulative Index Values	**Aquatic Index Rating**
23 and above	Excellent
17 to 22	Good
11 to 16	Fair
10 to less	Poor

Group I	Group II	Group III
1. hellgramite 4. caddisfly	*1. dragonfly*	*1. black fly*
2. mayfly 5.	*2. crayfish*	*2. freshwater worm*
3. snail	*3.*	*3.*

(3 x 4) + (2 x 2) + (1 x 2) = 18

[18 is the aquatic index value, which is a good rating according to the chart above]

Adapted from *A Field Manual for Water Quality Monitoring*, An Environmental Education Program for Schools by Mark K. Mitchell and William B. Stapp.

4. How would you describe Park Lake's water quality based on its Aquatic Index?

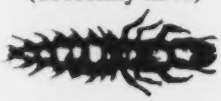
5. What do you think has caused or contributed to the water quality?

Pollution Tolerance of Macroinvertebrates

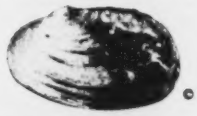
Group I - Index Value = 3
These macroinvertebrates can not tolerate pollution or changes in water quality. Their presence or dominance generally indicates good water quality.

Mayfly nymph

Hellgrammite
(dobsonfly larva)



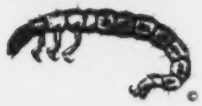
Freshwater mussel



Stonefly nymph

Riffle beetle adult

Caddisfly larva

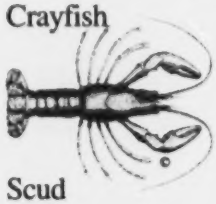


Group II - Index Value = 2
These macroinvertebrates can exist in a wide variety of water quality conditions.

Dragonfly nymph

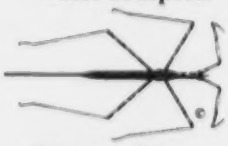
Damselfly nymph

Crayfish

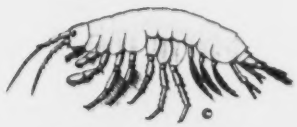


Predaecous diving beetle

Water scorpion



Scud



Whirligig beetle

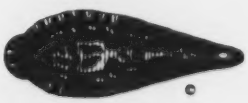
Water strider

Isopod (Sowbug)

Group III - Index Value = 1
These macroinvertebrates can exist in polluted water. Their dominance indicates poor water quality.

black fly larva

leech



freshwater worm

McCafferty, Aquatic Entomology
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Key to Aquatic Macroinvertebrates

Macroinvertebrates

with shells

double shell

shell attached to submerged objects

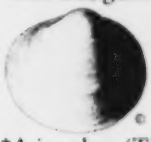
*Zebra mussel (T)

shell unattached

shell oblong

Native freshwater mussel (I)

shell triangular



*Asian clam (T)

single shell

obvious legs

three pairs of legs

two pairs of wings

chewing mouth parts, front wings thick (beetles)

hind legs short (swims on surface)

Whirligig beetle Adult (M)

hind legs long

hind legs paddle-like (swims rapidly)

Predaceous diving beetle (M)

hind legs not paddle-like (crawls on submerged objects)

Riffle beetle adult (I)

sucking mouth parts (true bugs)

thin body, long spider-like legs

skates on water surface

Water strider adult (M)

walks on bottom near plants

Water scorpion adult (M)

thick body, up to 3" long

Giant water bug adult (M)

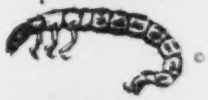
no wings, some undeveloped wing pads

entire body soft except head and thorax

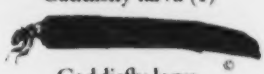
dark brown to black body, prominent pinching jaws

Hellgramite, Dobsonfly (I)

white to greenish body, with or without portable case



Caddisfly larva (I)



Caddisfly larva with case (I)

** Non-native nuisance species. The Zebra mussel is not yet known from North Carolina. It is moving into the southern states. Report its occurrence to Park, Wildlife or Duke Power authorities.*

of the Catawba River Watershed

LEGEND	
Pollution Tolerance	**Index Value**
(I) – Intolerant	Group 1
(M) – Moderate	Group 2
(T) – Tolerant	Group 3

without shells

no obvious legs

more than three pair of legs (crustacea)

small claws on front legs

body flattened side to side

Anphipod scud (M)

body flattened top to bottom

Isopod, Sowbug (M)

large claws on front legs

Crayfish (M)

worm-like

small appendages

no obvious head (lives on submerged leaves and moss)

Cranefly larva (M)

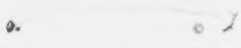
obvious head

rounded abdomen (attached to rocks and sticks, lives in groups)

Black fly larva (T)

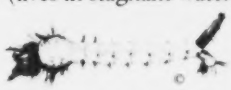
slender abdomen

bright red body (lives on submerged objects)



Chronomid midge (T)

small hairs on body (lives in stagnant water)



Mosquito larva (T)

no appendages

flattened, gray to black color

Leech (T)

cylindrical, red color

Aquatic worm (T)

sponge or jelly-like, grows on submerged objects

usually a flattened pad

Freshwater sponge (M)

ball-like

Bryozoa (M)

entire body exoskeleton hardened, flattened

no obvious tail

Dragonfly nymph (M)

obvious tail

three tails

tails broad, leaf-like

Damselfly nymph (M)

tails slender, gills on abdomen

Mayfly nymph (I)

two tails, no gills on abdomen

Stonefly nymph (I)

McCafferty, Aquatic Entomology
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Duke Power State Park, NC

4.1.11 53

November 1993

On-Site Activity #2 — Water Lab

Major Concepts:
- Water quality
- Temperature
- pH
- Turbidity

Learning Skills:
- Observing, communicating, interpreting data
- Measuring
- Reading and interpreting scientific charts

Subject Areas:
- Science
- Mathematics
- English Language Arts
- * See the Activity Summary for a Correlation with the DPI objectives in these subject areas.

Location:
The swimming area picnic shelter near the park lake

Group Size:
Maximum of 25 divided into three groups, one adult per six students

Time: 1 hour

Appropriate Season:
Spring, summer or fall

Credits: The Water Quality Information Sheet was adapted from "A Lesson Plan for Some Water Investigations," Investigating Your Environment Series. US Forest Service, Revised 1977. Printed with permission.

Materials:
Provided by the park: life jackets, pH kits, vinegar, ammonia, two plastic cups, basters, large bucket, large clear plastic jar containing water sample from Lake Norman, large empty clear plastic bottle, Water Lab Data Sheet, thermometer, Water Quality Information Sheet, white paper, Secchi disk with string
Provided by educator:
Per team: one copy each of the data sheet and the Water Quality Information Sheet

Safety Considerations:
Because students will be on the beach when taking the pH reading, and on the boat dock when the temperature and turbidity readings are done, they will all be required to wear life jackets.

Objectives:

- Name and describe three characteristics of water that contribute to the overall quality of a water sample or body of water.
- Determine the pH, temperature and turbidity of lake water samples and make inferences regarding the overall water quality based on the test results.
- Using the test results and other information, write predictions for the kinds of aquatic life that might live in the lake.

Educator's Information:

In this activity students will conduct some simple physical and chemical tests to determine the quality of a body of water. Working in teams, students will determine the pH, turbidity, and temperature of park lake water samples and record their findings on their data sheets. Using the data collected and the Water Quality Information Sheet, they will predict the type of life that the park lake can support and draw conclusions regarding the overall water quality of the lake.
To insure the success of this activity, teachers should conduct one of the pre-visit activities and do the guided practice suggested in the Instructions for this activity. If time permits, students should also do the on-site activity, "Life at the Bottom," as a follow-up. This will help the students check the accuracy of their predictions about the types of aquatic life inhabiting the park lake.

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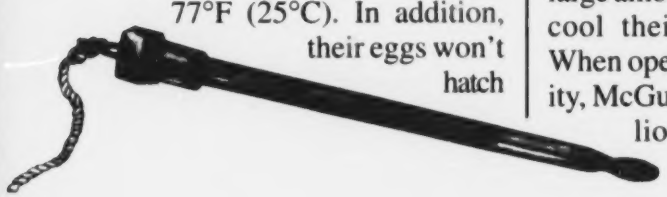
Student's Information:

Water quality is a term used to describe the ability of a body of water to support life. Several characteristics of the water must fall within certain ranges if the water is to be considered "safe" for people to drink or for wildlife to use. Lake Norman, the park lake, and other bodies of water can only absorb certain amounts of pollutants before the overall water quality goes down. Then, animals die and people get sick.

When you come to Duke Power State Park, you will be measuring three characteristics of water: temperature, turbidity, and **pH**. After making your measurements, you will have a good idea of the overall water quality of the park lake. You will also be able to predict the kinds of animals that could live there.

Temperature

Water temperature is a life or death factor for the many animals, plants, and microorganisms living in water. Most trout, which thrive in cold water, will die if the water temperature gets as warm as 77°F (25°C). In addition, their eggs won't hatch if the water is any warmer than 57°F (14°C). Carp, on the other hand, are considered "warm water" fish. They can easily withstand water temperatures as warm as 100°F (38°C).



Temperature also affects **dissolved oxygen**, or the amount of oxygen dissolved in water. Fish and other aquatic animals need the oxygen that is dissolved in water. When the oxygen level falls below a certain point, they die. The rule--the warmer the water, the less oxygen it can hold. The reason--as water temperatures rise, dissolved oxygen escapes from the water and into the air. Some animals need more dissolved oxygen than others. Therefore, water that is considered deadly and polluted for some fish, because of low dissolved oxygen levels, may be perfectly safe for other fish. (See the Water Quality Information Sheet for temperature ranges and dissolved oxygen requirements for **aquatic** organisms.)

Many factors such as weather, the seasons, and man-made facilities affect water temperature. According to Duke Power Company, McGuire Nuclear Station and Marshall Steam Plant--both located on Lake Norman--use large amounts of lake water to cool their steam turbines. When operating at full capacity, McGuire circulates 2 million gallons of lake water a minute. The lake water helps condense the steam produced to turn the turbines. The water used for cooling is eventually returned to the lake, slightly warmer than the rest of the lake water. According to Duke Power Company, the water is not warm enough to hurt fish or other aquatic life.

The area where the McGuire Nuclear Station discharges warm water into Lake Norman is known as a "hot spot" and is very popular with fishermen, especially in winter. Why? Because shad flourish in the warm waters and many larger game fish go into these waters to feed on shad. Since the lake is large, the fish can migrate back and forth between warmer and cooler areas.

Another factor affecting water temperature is a natural process called **thermal stratification**. This process occurs to some degree in all bodies of water, including lakes and ponds. In thermal stratification, waters of different temperatures form separate layers in the lake. The lighter, warmer water floats on top of the denser, cooler water. These two separate layers provide different habitats where different types of aquatic plants and animals live, mainly due to the differences in temperature.

This is why fish that need to live in cooler water, such as trout and striped bass, swim to the deeper parts of lakes during warm summer days.

pH

pH is a measure of how **acidic** or **basic** something is. Scientists use a pH scale to define degrees of acidity. The scale is represented by numbers from 1 to 14. A pH of 1 is extremely acidic, while a pH of 14 is extremely basic, or alkaline. A pH of 7 is neutral, neither acidic or basic. Pure water has a pH of 7. Some examples of the pH of common things around you include:

Vinegar pH of 2.25
Cola pH of 4
Rain pH of 5.6
Milk pH of 6.5
Sea Water pH of 7.5

pH Scale
1-------7------14
acidic neutral basic

If you look at the Water Quality Information Sheet, you will see how pH affects plants and animals. Bacteria can live at almost any pH level from 1 to 13. Most plants and animals, however, can't survive for very long in water that is below pH 6.0 or above pH 9.0.

Many factors affect the pH levels in a lake. Every day millions of cars emit a gaseous pollutant called nitrogen oxide. Nitrogen oxide mixes with water vapor in the air to create **acid rain**. In addition, thousands of factories and electric power plants release more gases such as sulphur dioxide into the air. These gases create more acid rain. The acid that falls to earth lowers the pH level of lakes, rivers, and streams. In some places in the world, the water is so acidic that it is called "dead." The water may look clean and pure, but nothing can live in it and no one can drink it.

Marshall Steam Station is a large plant on Lake Norman which burns coal to generate electricity. This plant emits sulphur dioxide into the air. This plant is one of the many sources of acid rain in our area. It is difficult to determine how much this power plant is actually affecting the pH of Lake Norman.

In addition to acid rain, **runoff** affects the pH level of the lake. When it rains, extra fertilizers from farm fields run into the lake. Most fertilizers contain nitrogen which lowers the pH of the water. Runoff from people's yards can add more nitrogen to the lake. Some homeowners use lime, which is very basic, to make their grass greener and healthier. If lime washes into the lake, it may cause pH levels to go up.

Wastewater treatment plants also have an impact on pH levels in the water. There are a number of wastewater treatment plants in your home town and on Lake Norman. Whenever we use the bathroom, take a shower, wash dishes, do laundry, or wash a car, the dirty water is piped to a wastewater treatment plant.

Here it is cleaned and released back into the lake. Many of the household cleaners we consistently flush down the drain are basic, but some are very acidic. Occasionally, treatment plants are overloaded and are unable to bring the pH to a more neutral level.

Turbidity

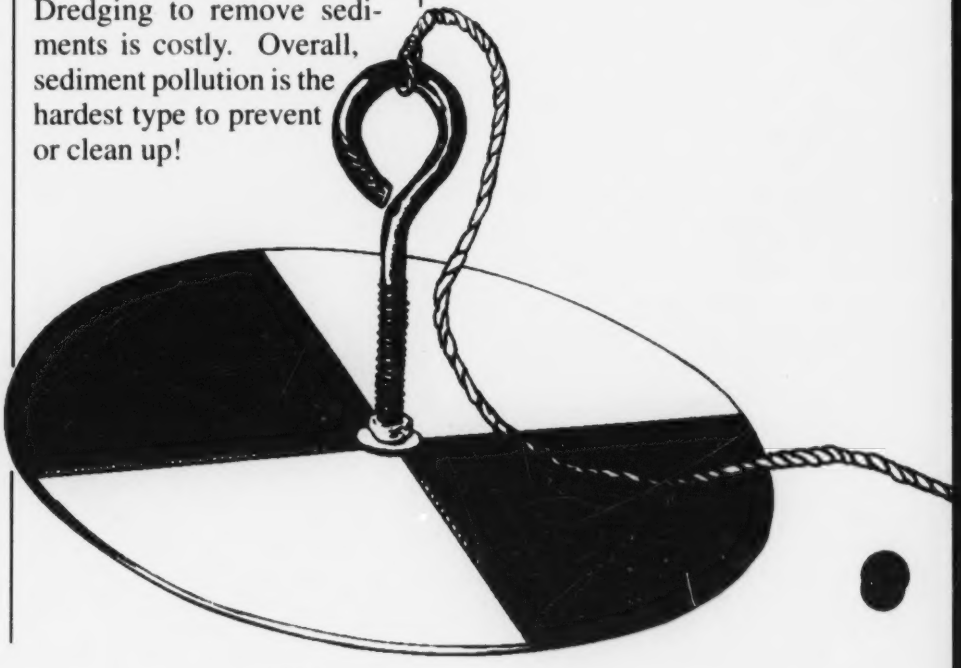
Turbidity refers to the amount of **sediment** or foreign particles suspended in water. Turbidity is another indicator of water quality. Very muddy, dark, or dense water would be called turbid. Turbidity is determined by a number of factors, both natural and man-made.

Very green-colored water may be overpopulated with algae. This could be the result of extra fertilizers from agricultural runoff. A tan, murky color may be the result of a heavy load of **silt**. Silt is a very fine-grained sediment that doesn't easily settle out of running water. Silt particles will settle out if the water sits undisturbed for a few days. A body of water that is a reddish color is full of suspended clay that has not yet settled to the bottom of the water. A weak tea or coffee color in otherwise clear water indicates decomposing leaves and bark. Tannin or tannic acid from decaying leaves is a major contributor to the turbidity of water. This same color may also be an indicator of chemical pollution.

Too much sediment sitting on the bottom of a lake can destroy the habitat for bottom-dwelling animals. Sediments can also directly smother these animals or their eggs and larvae. If the smaller animals are killed, the larger animals that depend on them for food will have to find food elsewhere or die. In this way, sediments can destroy the food chains or food webs of an entire lake. People who depend on fish, or other aquatic animals, for their livelihood are also affected.

Sediments can cause reservoir volumes to decline by displacing water with soil. This reduces the storage capacity of the reservoir. It will not be able to hold as much drinking water or absorb as much floodwater. Large silt deposits at the mouths of rivers, or in lakes, can cause navigation problems for boats. Dredging to remove sediments is costly. Overall, sediment pollution is the hardest type to prevent or clean up!

A Secchi disk is one device that can be used to measure turbidity. The disk is lowered into the water until it disappears from view. The depth of the disk can be read from the marked rope. For still water, a Secchi disk reading of 5 feet or less indicates the water is very murky. A large number of particles are probably suspended in the water. A reading of 20 feet would indicate fairly clear water with few suspended materials. Clearer water allows the sunlight to reach great depths. Submerged aquatic plants can grow at greater depths in these situations.

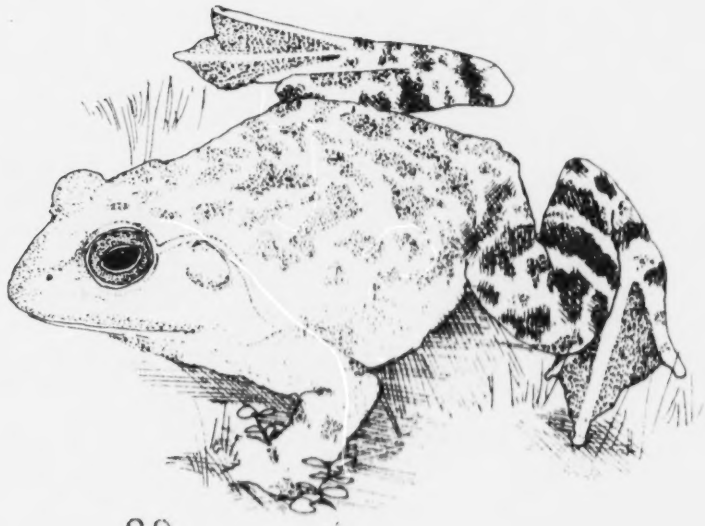


Predicting Aquatic Animals

After you determine the temperature, pH and turbidity of the water in park lake, you will use the Water Quality Information Sheet to predict the kinds of animals that might live there. There are a few things to keep in mind when you make your predictions:

The animals in a river or lake reflect the worst possible conditions in that body of water. If the water temperature is extremely high for one week of the year, it could kill certain kinds of animals that might normally be able to live there. The temperature readings that you take when you visit Duke Power State Park may not be very high. Based on your readings, you may predict that many kinds of animals should be able to live in the lake. Remember that water quality can change from day to day. One significant pollution event could destroy animals and their habitat. It could take a long time for the animals to return.

It is also important to remember that Lake Norman is a man-made lake. Most of the aquatic animals that live in Lake Norman or the park lake once lived in a river or stream environment. However, only the animals that were able to survive when the river was converted into a lake are found in Lake Norman today. Scientists call these animals "tolerant" because they are able to survive fairly large changes of temperature, pH, and turbidity. They can exist in a wide variety of water quality conditions. Animals that are less tolerant of change were probably eliminated when the river was converted to a lake.



Instructions:

1. Before departing for the park, thoroughly go over the Student's Information with the class and explain to them the types of tests they'll be conducting at the park. Divide the students into teams of three. Conduct a guided practice of some of the skills the students will be performing at the park.

Suggestions:

If you have thermometers available, let the teams practice taking air temperature readings in the classroom and on the school grounds. If you have litmus paper, let the teams take pH readings of various materials such as tap water, soda, milk, vinegar, bleach, hand soap, etc. Although the students will be using a more sophisticated test for pH at the park, the litmus paper test will familiarize them with the pH ranges of common materials. You could also give each team one copy of the Water Lab Data Sheet and Water Quality Information Sheet. Then, explain how to make predictions using the Water Quality Information Sheet. For example, if a student team discovers that the pH of the lake water is 6.0, what types of organisms could live in the water? (Answer: bacteria, carp, suckers, catfish, some insects)

If the water temperature is 69 degrees, what kind of organisms could survive? (Answer: much plant life, many fish diseases, most bass, crappie, bluegill, carp, catfish, and caddisfly)

2. Upon arrival at the park, the park staff will review the Student's Information, describe the tests to be conducted, and demonstrate the safe use of equipment such as the pH kits, thermometers, and Secchi disks. The park staff will hand out the data sheet and Water Quality Information Sheet to each team.

3. The teams will be divided into three larger groups. The large groups will rotate through three water quality testing stations: pH, turbidity and temperature. After each group completes its test, the groups will switch stations until all teams have completed all three tests. Remind the students that they should take turns within their teams to conduct the tests and record the data. Instructions and procedures for each test are given in this EELE.

4. When all the teams have done all the tests, gather the students together at the picnic shelter for a follow-up discussion. Ask individual teams to report their findings and predictions. Discuss the information in "Predicting Aquatic Animals" (Student's Information) again for emphasis.

5. If time permits, do On-site Activity #1, "Life at the Bottom." Did the student's observations of aquatic life match their predictions made during the "Water Lab" activity?

Temperature Test

1. Lead the group to the boat dock area to conduct the temperature tests. One student in each team will be responsible for handling the thermometer, another for recording the data, and a third for timing the temperature test. Demonstrate the procedure for taking temperature at various depths.

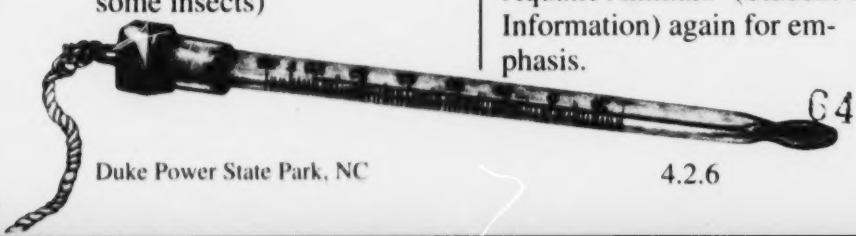
2. First, holding the thermometer in a shaded place, have the students determine the temperature of the air. Caution them to avoid touching the thermometer bulb.

3. Next, to measure the temperature of the surface water, grasp the end of the thermometer and place the bulb just under the surface of the water. Hold this position for two minutes.

4. Lower the bulb three feet (measured along the premarked string), wait two minutes, and take another temperature reading.

5. Lower the bulb to a depth of six feet, wait two minutes, and take another temperature reading.

6. Have the students record each temperature reading on their data sheet. Surface waters will be somewhat warm-



er (except in winter) than deeper waters. Not only do surface waters absorb more sunlight, but warm water "floats" on colder water. Note: Water is the most dense at 39 degrees Fahrenheit (4 degrees Celsius). Water cooler than 39 degrees Fahrenheit will float on top of this warmer water! This is why ice forms on the lake surface rather than the lake bottom.

7. Using the data collected and the information sheet (section on temperature ranges), have the students describe what type of life they think might be present.

pH Test

1. Lead the group to the beach area to conduct the pH test.

2. Demonstrate to the class the different extremes on the pH scale by using the pH kit to measure the pH of a cup of vinegar (very acidic) and a cup of ammonia (very alkaline). Demonstrate how to conduct a pH test on lake water samples, as described below.

3. Each group will receive a baster and pH kit.

4. Collect a sample of the park lake water in a large bucket. Have one member of each group use the baster to draw water from the bucket and place it into the tube in the pH kit, filling the tube to about a quarter-inch from the top.

5. Have another team member place one drop of the indicator solution in the tube, place the lid on the tube, shake it and wait 10 seconds. Have all three students compare the color of the solution in the tube with the chart on the front of the pH Kit and choose the number of the color it most closely resembles.

6. Have the third student record the pH reading on the team's data sheet.

7. Using the data sheet and information sheet (section on pH ranges), discuss the results. Have the students describe the health of the water in terms of its pH level. What life might they expect the water to support, and would they not expect it to support? (Possible answers: Support — bacteria, algae, bass, crappie, trout, mayfly, stonefly, bass, crappie, caddisfly, carp, catfish. Not support — snails, clams, mussels). What factors may have contributed to this pH reading? (Possible answer: nitrogen oxide from automobiles and sulfur dioxide from factories which contribute to acid rain, agricultural runoff — surplus fertilizers containing nitrogen which wash into our waters, lime from residential runoff, decaying vegetation in water). How does the pH of the park lake compare with the pH level of Lake Norman (the park staff would have taken this reading prior to the program)? (Possible answer: Lake Norman is slightly less acidic than the park lake. Why? Because Lake Norman has such a huge volume of water that potential pollutants are diluted significantly. Lake Norman can handle more pollutants than a smaller lake before the overall water quality is affected.

Turbidity Test

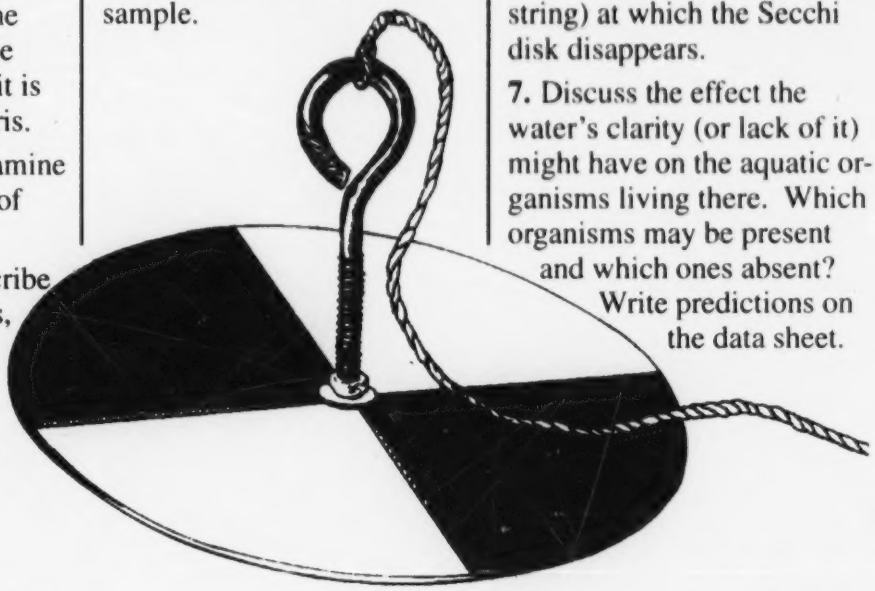
1. Lead the group to the boat dock area (away from temperature testers) for the turbidity test.

2. Collect a sample of the park lake water in a large plastic jar, making sure it is free of any obvious debris.

3. Have the students examine it against a background of white paper.

4. How would they describe the color? Is it colorless, greenish, murky tan, a clear tea or coffee color? Discuss the possible explanations for the color.

5. Present a glass jar which has a water sample taken from Lake Norman. Place it against a background of white paper and discuss how it differs from the park lake sample.



6. Have one member of each team lower a Secchi disk into the water slowly and the other two observe and record on the data sheet the depth (measured along the pre-marked string) at which the Secchi disk disappears.

7. Discuss the effect the water's clarity (or lack of it) might have on the aquatic organisms living there. Which organisms may be present and which ones absent? Write predictions on the data sheet.

WATER LAB DATA SHEET

Date: _____

Team members' names: _____

_____

pH of Park Lake Sample: _____

Predictions of aquatic life: _____

_____

_____

Temperature Readings:

Air temperature _____ Surface water temperature _____

Temperature at different depths:

3 ft. _____ 6 ft. _____

Predictions of aquatic life: _____

_____

_____

Turbidity:

Depth where Secchi disk disappears: _____

Predictions of aquatic life: _____

_____

_____

Describe the overall water quality of the park lake and the kinds of organisms you might expect to find there. _____

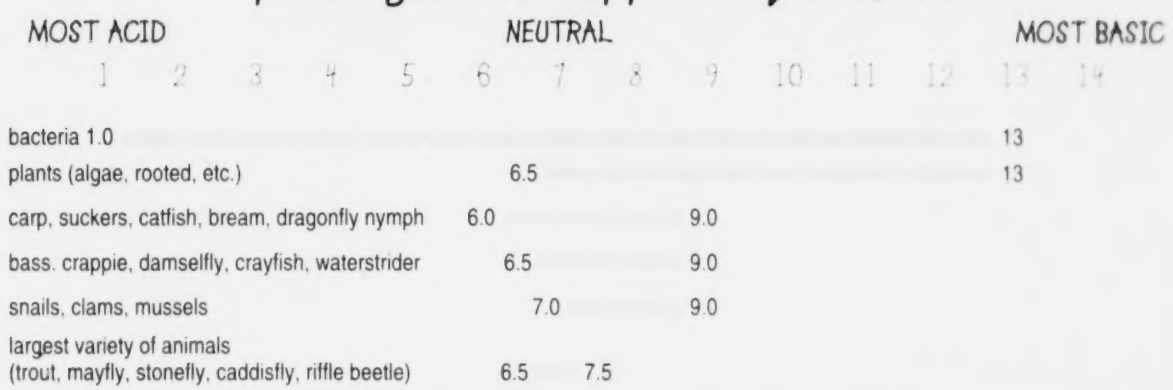
_____

_____

_____

WATER QUALITY INFORMATION SHEET

pH Ranges That Support Aquatic Life



Temperature Ranges (Approximate) Required for Certain Organisms

Temperature	
Greater than 68° F (20° C) warm water	much plant life, many fish diseases most bass, crappie, bluegill, carp, catfish, caddisfly, dragonfly, damselfly, water scorpion, diving beetles, crayfish, scud, water strider
Middle range: 55° - 68° F (12.8° - 20° C)	some plant life, some fish diseases salmon, trout, stonefly, mayfly, caddisfly, water beetles, blackfly larva
Low range: Less than 55° F (12.8° C) cold	trout, caddisfly, stonefly, mayfly, hellgrammite, freshwater mussel

Dissolved Oxygen Requirements for Native Fish and Other Aquatic Life
D.O. in parts per million

(below 68°F)	(above 68°F)
Cold water organisms (including salmon and caddisfly stonefly, mayfly, hellgrammite)	Warm-water organisms (including fish such as bass, crappie, catfish and carp)
6 ppm	5 ppm

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On-Site Activity #3 — Lake Watchers

Major Concepts:
- Water quality
- Dams
- Runoff
- Sedimentation
- Turbidity
- Urbanization
- Recreation
- Water pollution
- Aquatic life

Learning Skills:
- Observing, communicating, inferring
- Collecting, analyzing and evaluating information
- Map reading, taking responsible action

Subject Areas:
- Science
- English Language Arts
- Social Studies
- * See **Activity Summary** for a Correlation with DPI objectives in these subject areas.

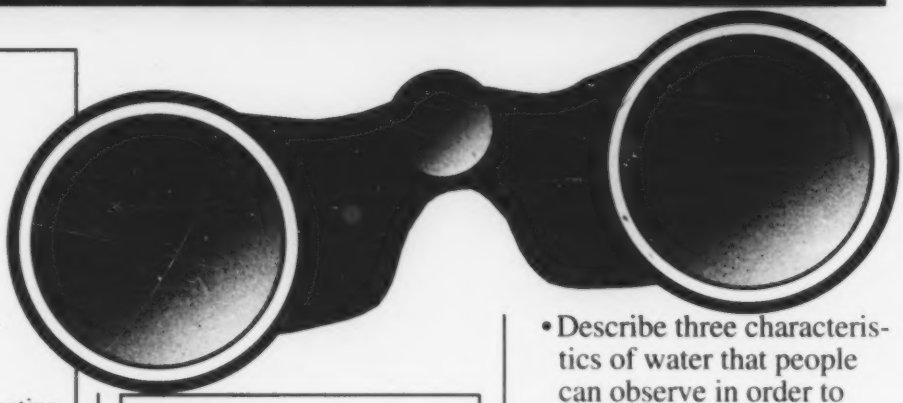
Location: Alder Trail

Group Size: 30 or less, preferably in groups of 10 or less with a minimum of one adult leader per group

Time: 1 - 1 1/2 hours

Appropriate season:
Any — spring and fall recommended

Special considerations:
- Leaders should scout trail before walk to become familiar with recommended stops and to recognize potential hazards (i.e. slippery rocks, cliffs, poison ivy, etc.)
- Leaders should carry first aid kit, water, whistle, and a throw rope.



Materials:
Provided by park:
Per each adult leader: one leader's kit containing a throw rope, whistle, topographic map, *Pond Life* guide, and several laminated Lake Watchers Investigation Charts
Per each pair of students: one litter bag
Provided by the school:
Per class: one first aid kit and water bottle
Per adult leader: one copy of the Lake Watchers Teacher's Guide and Lake Watchers Investigation Chart

Objectives:

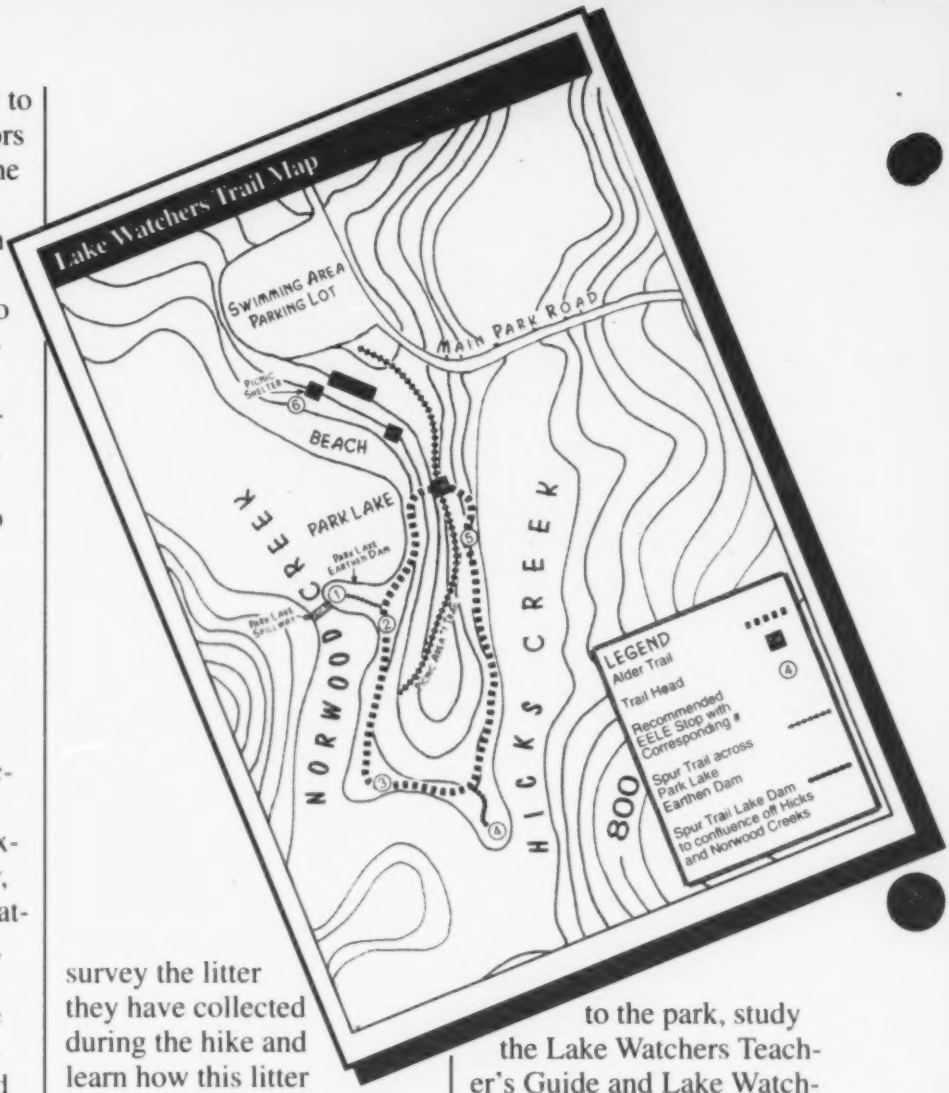
- Describe three positive effects and three negative effects of dams on people and wildlife.
- Describe two ways that people can minimize the negative environmental impacts of dams.
- Identify three examples of aquatic plants and animals found in the field.
- Use a topographic map to identify direction, elevation and landmarks in the field.
- Describe three characteristics of water that people can observe in order to make inferences about water quality.
- Explain how urbanization affects water quality.
- List two negative impacts of recreation on water quality.

Educator's Information:

This activity is a hike which takes place on the Alder Trail, an easy 3/4 mile loop trail. The trail follows the shoreline of a large peninsula located between the Hicks and Norwood creek sections of Lake Norman. The purpose of this activity is to provide students with a firsthand look at some of the factors that affect water

quality and the opportunity to study their effects. Educators will guide students along the trail, stopping at different locations. Depending upon the season, students will also have the opportunity to observe and identify examples of aquatic flora and fauna including turtles, waterfowl, and various plants. Take advantage of these unexpected events and stop and enjoy them.

At Stop #1, the students will examine the park lake dam, discuss the reasons dams are constructed, and identify the benefits and drawbacks of dam construction. At Stop #2, they will look closely at the water, examining the color, turbidity, presence or absence of aquatic plants and animals, odor, and presence or absence of suds or films. They will be encouraged to use their observation skills to study and monitor bodies of water in their communities. At Stop #3, students will examine red clay and learn how extensive farming practices have drained the soil of valuable nutrients. At Stop #4 they will see and locate on the topographic map the actual area they studied during the pre-visit activity "River Roots." They will also discuss the effects of urbanization on water quality. At Stop #5 students will examine shoreline erosion and the effects of recreation on water quality. At Stop #6 they will survey the litter they have collected during the hike and learn how this litter affects wildlife and people. At this final stop the students will also review and discuss what they learned during the hike. This hands-on interaction with the aquatic ecosystem will help students appreciate the natural resource and encourage them to become stewards of our environment.



Instructions:

1. To ensure the success of this on-site activity, we recommend you conduct Pre-Visit Activity #4, "River Roots" in this EELE.

2. Before bringing students to the park, study the Lake Watchers Teacher's Guide and Lake Watchers Investigation Chart. Visit the park to scout the trail yourself. Ideally, this should be done at least one week prior to your class' visit and at the same time of day. This will help you identify potential trail hazards (slippery areas, steep banks, etc.) and become familiar with the exact locations of the stops described in the Lake Watchers Teacher's Guide. You could also look for additional stops to view plants and wildlife.

If you are unfamiliar with aquatic environments, you will need to carry a field

guide or request assistance from park staff. An excellent all-purpose guide is *Pond Life* by the Golden Press. (See Reference section.) A list of commonly-observed wildlife is also included in this activity. Two important points to recognize when observing organisms are: (1) It's not always important to identify the specific name of a plant or animal as long as the students appreciate it and/or understand its place in nature; (2) It is important to help your students relate the plants and animals to water quality; i.e., their dependence or influence upon it.

3. Divide the class into smaller groups of 10 students or less. Provide one adult leader per small group. Give each leader a copy of the Lake Watchers Teacher's Guide and a Lake Watchers Investigation Chart prior to the hike.

4. During the hike, one of the group leaders should carry the first aid kit and water bottle. All the leaders should carry a throw rope, whistle, map of the area, a copy of Pond Life, and several Lake Watchers Investigation Charts. Each student should have a "buddy" in his/her group. Each pair of students will be given a small litter bag at the park to help with trail clean up.

5. Begin the hike with a brief introduction during which you will cover the theme, trail distance, time, difficulty, and special rules. Here are some rules to teach your students:

a. Stay on the trail until told otherwise.

b. Watch for roots, stumps, sloped walking areas, and other hazards. Running is not allowed on the trail.

c. Do not pick, injure or destroy any plants or animals in the park. (The purpose of the state parks system is to preserve and protect our natural resources.)

d. Being quiet will help you see more wildlife.

e. The adult leader should always be at the front of the group.

f. When picking up litter along the trail, do not touch broken glass, twisted metal or fishing line containing hooks.

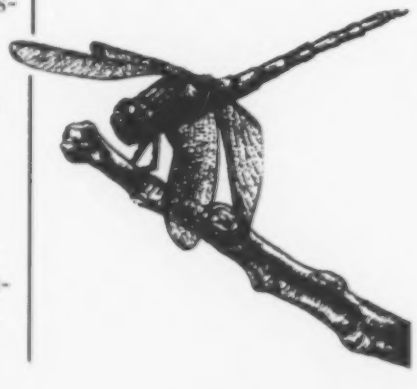
6. When conducting the hike, start each small group at a different stop along the trail so that the groups do not get too close to one another. Make sure all the leaders know the amount of time that they have to conduct the hike and visit all the stops. All groups should end their hike at Stop 6. Remind the leaders that when pausing for discussion or to view an interesting object along the trail, they should lead their group halfway beyond the object so that all will have a good view. Three loud blasts on the whistle always indicates an emergency. Be sure to review emergency procedures with all the leaders.

Extensions:

1. Have students participate in the *Aquatic Project WILD* activity, "To Dam or Not to Dam" where they role play individuals representing differing perspectives and concerns related to the construction of a dam on a river. See References under Western Region Environmental Education Council.

2. Have the students participate in the *Aquatic Project WILD* activity, "Something's Fishy Here" where they identify potential cause and effect relationships involving aquatic-related pollution; generate and evaluate alternative solutions to problems of aquatic pollution; and outline a plan to initiate environmental action to reduce the negative consequences of aquatic pollution in their communities. See References under Western Region Environmental Education Council.

3. Lead a walk in a different aquatic environment to compare and contrast water quality issues.



Stop 1: Park Lake Dam — What's It Good For?

Ask these questions to encourage the students to observe and make inferences:

1. What are the major features of the park lake dam?

concrete apron, spillway, wooden gates, large earthen barrier

Background information for teacher: The dam itself consists of more than just the small area of concrete and wood you see in front of you. It actually starts back where we took the sharp right off of the Alder Trail. Tons of dirt and stone were brought in to create an earthen barrier to hold the water inside the park lake once the dam was built and Norwood Creek began to back up and expand far beyond the sides of the original creek bed.

2. Why do you think this dam was built?

It was constructed across Norwood Creek to create a safe swimming area where motor boats are not permitted.

3. Look closely at the concrete once again. Why do you think it was built to allow a small amount of water to flow over it?

This feature is called a spillway. It allows the park lake to remain at a constant level throughout the year, unless there is an exceptionally heavy period of rain or lengthy drought. The lake is much safer for swimming when it is maintained at a constant water level.

4. What is the purpose of the two wooden gates on each side of the spillway?

The gates allow more water to be released at one time.

Background information for teacher: Sometimes rangers may need to open the gates to let water flow out of the lake at a faster rate than usual. For example, it may rain so much that the spillway alone can't release enough water to prevent flooding.

Stop 2: Small Cove Beyond Dam — Be a Lake Watcher!

Script — "We are now on the Lake Norman side of the dam. This creek, Norwood Creek, is a part of Lake Norman. Did you know that, without any expensive equipment, you can begin to determine the quality of water? That's right — all you need is your ability to make good observations with your eyes and your nose. If the water looks or smells unusual, there is probably something wrong with the water quality. Let's use the Lake Watcher's Investigation Chart to help us make inferences about the water quality of Norwood Creek."

Pass out the Lake Watchers Investigation Chart and challenge students to make careful observations. Warn the students that if they smell any strong odors or see anything unusual in the water, they should not touch the water. Let them work with their "buddy" to make inferences from their observations about the water quality in the creek.

In addition to the observations included in the chart, students should also look for the presence or absence of aquatic plants. If no aquatic plants are present, this could indicate that the water is too turbid to allow sunlight to penetrate. Of course, if students find dead fish or other dead animals, this could indicate very serious water quality problems. When students have completed their investigation, ask them if they think the water in the creek is becoming polluted. What could be done about it? Please report your findings to the park.

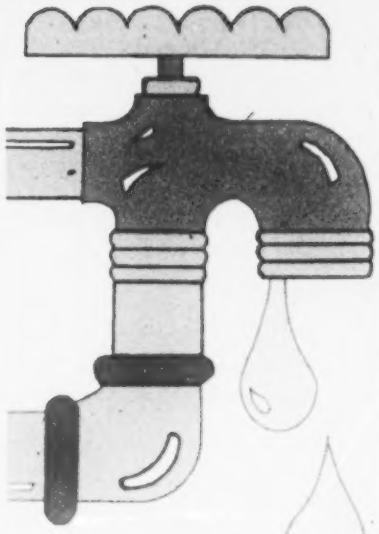
Script — "Making sure that our water remains safe for wildlife and people is a very important task, and one in which you can be involved.

Be a lake watcher! Take time to investigate streams, ponds, and lakes in your communities as we have done here today. If you see something suspicious, notify the police department or North Carolina Wildlife Resources Commission. Help protect your drinking water!"

Stop 3: Exposed Red Clay Area — "Bygone Days"

Script — "Look at all the red clay that is present here. Feel how slick and firm it is. What does it smell like? Why do you think we see so much red clay here and so little vegetation? Long before there was a Lake Norman, before the dam was built, the land beneath the lake was farmed extensively. Cotton and corn were major crops in the area. The fertile lowlands near the river were filled with valuable nutrients and moisture and were ideal for farming. But after decades of farming, the nutrients in the soil were mostly used up, leaving behind the red clay we see here. This red clay forms much of the lake bed in Lake Norman and lacks the nutrients needed by aquatic vegetation for growth.

The fact that young Virginia pines dominate this area rather than a mature hardwood forest indicates that not too long ago this area was farmland. In the process of succession, Virginia pines



are one of the first trees to inhabit an area which was once field. Let's learn how to identify this tree. The Virginia pine has short (1 1/2 - 3 inches), twisted needles in bundles of 2."

Guided Imagery Exercise (as time permits) —

Ask students to sit down on the ground and close their eyes. Tell students that you are going to describe what life in this area may have been like more than 100 years ago. The students should try to imagine what you are describing.

Script — "We are going to travel back in time to the early 1800s. There is no park lake, in fact there is no park! There aren't many trees because the forests have been cleared for farming. You live in an old farm house that your grandfather built in 1750 near the Power Spring Branch of Norwood Creek. You get your water from a spring and your mother does the family laundry in the creek.

You share the farm house with six brothers and sisters. You sleep on a mattress made of straw and your bathroom is an outhouse! A family cow provides milk and the flock of chickens in the hen house provide eggs. You eat a lot of corn meal muffins because corn is a major crop on your farm.

Everyday you help your parents farm the fields down

near the river. You have to work very hard to raise enough cotton and corn to help feed the family. John Cavin, a neighbor, has recently established a grist mill on Hicks Creek. You really enjoy hooking up the horse and wagon and travelling to the mill with your father. It is a welcome relief from all the hard work in the fields.

You don't have any TV or video games, so you find your fun in other ways. Your favorite place to play is the Catawba River. You like swimming there, but your mother won't let you swim alone. The current is so swift that it would be easy to drown. You like to fish and sometimes you race toy boats made of sticks with your brothers and sisters. You really enjoy boating downstream to your uncle's farm. Of course, you don't have a motorboat and you have to row hard to get back upstream again. Still, you like being in the boat and one day you want to see the ocean.

The world was very different back then. As you grew up, you realized that the fields were producing less and less because the topsoil was washing away. You knew you would have to make your living elsewhere, maybe in the big city of Charlotte!

Let's come back slowly to the present now. Open your eyes. What if you had really lived back in the 1800s and were still alive today? What changes would you see if you came back to your old homestead? What changes do you think are good? What changes are not so good?"

Stop 4: Confluence of Hicks and Norwood Creeks — Topo Exercise

If the teacher did not use "River Roots" as a pre-visit activity, the leader may have to explain to the students how to read a topographic map. First, see if the students can point out due North (without looking at the map) and then use the map to see how close they came. How could this map help if you were lost?

Next, the leader should point out major features of the topographic map such as contour lines, symbols for dwellings, numbers indicating elevations, and the fact that there is a 10 foot change in elevation between each contour line. Challenge the students to match landmarks or features that they can see around them with those on the topographic map. **Possible questions:**

- Can you find our location on the map? What is the approximate elevation? (Answer: 760 ft.)
- How far is it by boat from our location to Lake Norman (**Answer:** about 2-3 miles)
- What would happen if you got into a boat here and travelled to the left? (**Answer:** you would eventually go under a bridge.)
- Looking at the map, is there much development along Hicks Creek? Why or why not? (**Answer:** No, the area on the right side of Hicks Creek is state park land. The land on the left is owned by Crescent Land & Timber and has not yet been developed.)
- Find the Rocky Creek area on the map; is it a developed area? (**Answer:** yes, there are many black squares indicating structures.)
- Looking at the map and also looking around you, what activities can you find that may affect the water quality of Lake Norman?

Background information for teacher: Currently Lake Norman has over 26,000 permanent residents living along its 520 miles of shoreline. Thousands more individuals live within the lake's watershed. (A watershed is all the land area that contributes runoff to a particular body of water.) Cities, towns, industries, farms, and other businesses are also located within the watershed. Together, all of these people and places can significantly impact Lake Norman's water quality.

As rain washes across lawns, fields, parking lots, etc., it washes fertilizers, soils, animal waste, toxic chemicals, petroleum products and other detrimental substances and carries them into Lake Norman. Even in

small amounts, these pollutants affect water quality as they can kill plants and macroinvertebrates which are essential to the lake's food web. Even in a lake as large as this one, pollutants can build up over time.

Stop 5: Hicks Creek Side of the Peninsula — Recreation Impacts

Script — "Look and listen. Do you see any fishermen or hear any boat traffic? In addition to the thousands of permanent residents of Lake Norman, there are many other visitors, especially on weekends and holidays. Fishing, boating, and water skiing are some of the most popular recreational activities on Lake Norman. Unfortunately, recreation is not all fun and games. See if you can observe any harmful effects caused by recreational activities."

Allow students to look around, cautioning them to stay on the trail away from the edge of the steep bank. After two or three minutes, ask students what they have found. Here are some possible answers:

1. Litter — this is the most obvious type of pollution that may be the result of recreational activities. Litter kills birds and fish when they become entangled in fishing line or six-pack rings. Some animals such as turtles may mistake styrofoam products for food and ingest the litter, thereby clogging their digestive systems.

2. Petroleum products — students may be able to see a multicolored sheen on the water, or they may infer this from their observations of boats on the lake. Failure to maintain boats properly, spilling gas while refueling and thoughtless disposal of oil, all contribute to petroleum pollution.

3. Shoreline erosion — this is a significant problem facing unprotected shores of Lake Norman. Motor boats force powerful waves onto the shore, eroding the banks. As the banks cave in, the soil breaks up and sediment enters the water. Some fishermen worsen the problem by cutting down trees along the shoreline to establish shelter for game fish. The tree roots that hold the soil in place can no longer do their job.

Stop 6: Picnic Shelter — Litter Survey

Script — "Okay, now its time for our litter survey. What are some of the different types of trash you collected on our hike? On a scale of one to 10, 10 being the most hazardous, how would you rate these items in terms of how potentially hazardous they are to wildlife and people? Why? Did you know, that:

- Styrofoam is often mistaken as food by fish and turtles. It does not break down for 500 years.
- A fish hook and line can also be a bird hook and line. The hook can get caught in the bill or wings of the birds causing them to be so tangled in the line they can't fly. Or the birds may cut off one of their legs if they pull too hard trying to escape. These hooks can also be treacherous for barefoot swimmers.
- Six-pack rings are deadly necklaces. Diving birds like ducks and geese cannot see the rings and will noose themselves carrying the rings with them until they strangle. The rings will cut into an animal's skin as it grows, causing great harm.

• Aluminum cans and plastic bottles are traps for small animals that get their heads stuck inside them and die of starvation.

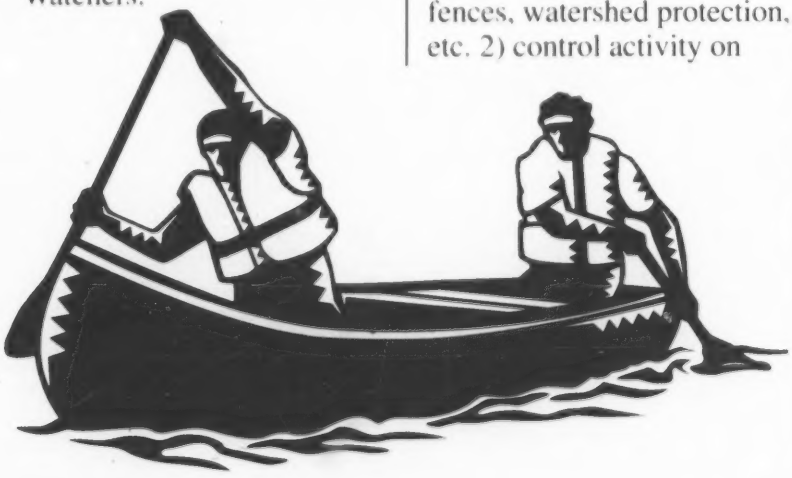
• Cigarette butts thrown in the water or on the ground are often eaten by wildlife. Fish and deer often mistake them for food and develop internal problems from eating them.

Let's throw all of the trash in the cans under the picnic shelter and leave our extra bags there too where the rangers can pick them up.

In addition to what we just learned about litter, what else have we discovered on our hike today?

• Why dams are constructed; their benefits and drawbacks; and how they affect water quality.

• We learned that expensive equipment is not necessary to investigate a body of water; that our senses of sight and smell work just great; and that we should get involved and become Lake Watchers.



• We discovered that much of the red clay we see along the shores of Lake Norman is the result of extensive farming practices which removed valuable nutrients from the soil.

• We learned that we are excellent topographic map readers and that urbanization can adversely impact water quality mainly due to the resulting runoff.

• We learned that recreational activities can ruin the beauty and safety of a lake if people behave irresponsibly."

Possible Discussion Questions (if time permits):

1. Do the effects of dams upon water quality outweigh their benefits?

Answer: Will vary, according to students' beliefs. Encourage students to explain their answers.

2. How, if possible, can the effects of dams upon water quality be reduced?

Answer: 1) control introduction of suspended solids or runoff through use of silt fences, watershed protection, etc. 2) control activity on lakes to minimize turbidity, etc.

3. What does the absence or presence of certain aquatic organisms indicate about the quality of water?

Answer: In aquatic environments, the presence or absence of certain organisms, called indicator species, reveals much about the quality of the water. Water with a rich and varied range of aquatic creatures is usually a healthy environment, whereas water with just a few species usually indicates less healthy conditions.

4. When you are being a Lake Watcher and you discover very green water, what could that mean?

Answer: It may mean the water is overpopulated with algae, possibly from too many fertilizers from agricultural runoff. How about if you discover water that is a weak tea or coffee color? In otherwise clear water it is an indication of the decomposition products of leaves and bark. This same color may also be an indication of chemical pollution.

5. What are some ways that residents, industries, farmers, etc. within the lake watershed can reduce their effects upon water quality?

Answer: 1) dispose of used oil properly (i.e. have oil recycled by taking to gas station); 2) use biodegradable or "environmentally safe" cleaners, herbicides, etc.; 3)

farmers could maintain forested creek bottoms and other wetlands to filter runoff.

6. What are some of the ways urbanization affects water quality?

Maybe you can think of some ways we didn't actually discuss on the hike.

Answer: 1) removal of forests that filter runoff and control erosion; 2) increased runoff from impervious surfaces, i.e. paved roads and parking lots and roofs, etc.; 3) introduction of treated wastewater that contains chemicals and nutrients into the water supply.

7. What are some of the ways to reduce the effects of boats upon water quality?

Answer: 1) properly maintain boats; 2) use extra care when refueling; 3) always secure litter when boating.

8. As individuals, what can each of you do to control litter?

Answer: 1) use trash cans; 2) participate in litter removal projects like "Big Sweep," an annual volunteer effort to clean up the state's waterways; 3) recycle.

9. Why is water quality so important to wildlife?

Answer: Water is essential to all life. Organisms need clean water to breathe, drink, reproduce, and grow.

Your Phrase to Remember:

**"Earth is home to us all.
Water is life to us all.
Share it responsibly."**

Common Alder Trail Aquatic Plants and Wildlife

Mammals
- Muskrat

Birds
- Kingfisher

- Great Blue Heron

- Wood duck

- Mallard ducks

Trees
- Smooth Alder

- River Birch

- Silky Dogwood

- Musclewood

Plants
- Cardinal Flower
- Giant Cane
- Rushes
- Grasses

Insects
- Water Striders

- Dragonfly

- Water boatmen

Fish
- Largemouth Bass

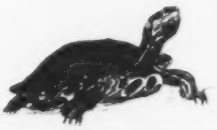
- Black Crappie

- Bluegill

- Channel Catfish

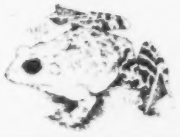
Reptiles
- Northern Banded Water Snake

- Painted turtle



Amphibians
- Salamander

- Bull Frog

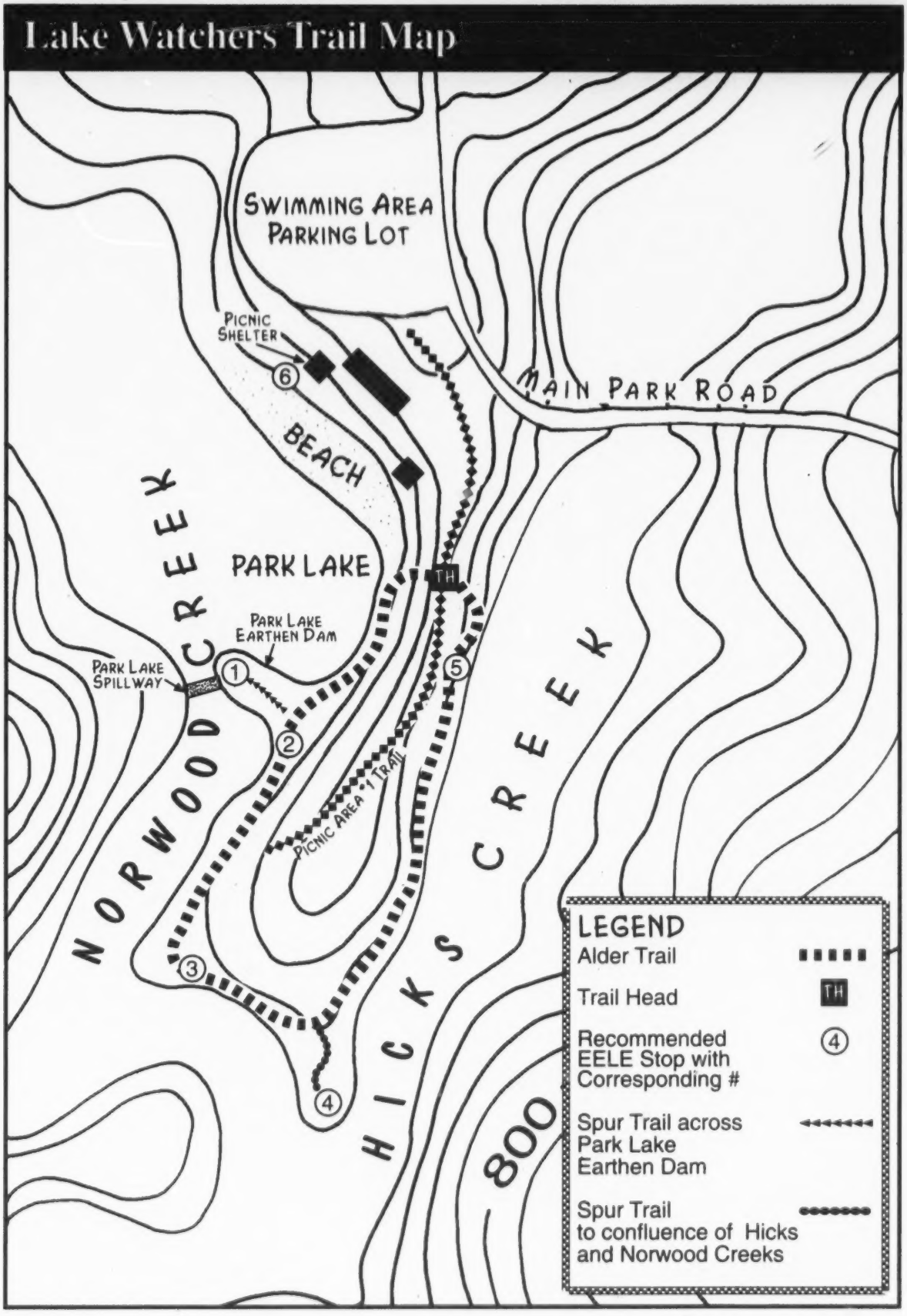


Miscellaneous
- Bryozoan Colonies

Lake Watchers Investigation Chart

OBSERVATIONS...	POSSIBLE CAUSE
very green color	Water is overpopulated with algae probably due to excess nutrients from runoff.
reddish color	Water may contain excessive clay particles that have not settled out yet (high turbidity).
tan, murky color	May be the result of a heavy load of silt, a very fine-grained sediment, due to erosion.
yellow coating on stream bottom	Indication of sulfur entering the stream bed
white cottony masses on bottom	This could be "sewage fungus" — gross!
multicolored sheen	See if you can break it up with a stick. If so, it is caused by bacteria as they decompose natural materials. If not, it is caused by petroleum products entering the stream.
foam on the water	When white and greater than 3 inches high, it may be caused by detergents. Tan foam can be caused naturally due to minerals in the water.
SMELLS . . .	
rotten egg odor	Could be caused by natural decomposition in a swamp or marsh ...or by sewage pollution if a marsh is not present.
musky odor	Could be caused by untreated sewage, livestock waste, or harmful types of algae.
bleach odor	May indicate that a sewage treatment plant is over-chlorinating the water.
unusual chemical odor	A chemical may be leaking into the water from a nearby source. Be careful!

Lake Watchers Trail Map



Post-Visit Activity #1 — Park Lake

Curriculum Objectives:
Grade 4
- Communication Skills: listening, reading, vocabulary and viewing comprehension; study skills using environmental sources
- Guidance: evaluate the importance of familiar jobs, competency for interacting with others
- Library/Media Skills: work independently and creatively in preparing assignments
- Science: living things–animals, adaptation to environment, interdependence of animals
- Social Studies: gather, organize and analyze information; draw conclusions, use maps, participate effectively in groups

Grade 5
- Communication Skills: listening and visual comprehension, study skills
- Guidance: competency and skill for interacting with others
- Science: earth science, environment
- Social Science: organize and analyze information, draw conclusions, use maps, participate effectively in groups

Grade 6
- Communication Skills: listening and visual comprehension, study skills
- Guidance: competency and skill for interacting with others
- Healthful Living: environmental health
- Science: ecology
- Social Science: organize and analyze information, draw conclusions, use maps, participate effectively in groups

Location: Classroom

Estimated Time:
One to three 45 minute periods

Appropriate Season: Any

Credits:
This activity was adapted from the Aquatic Project WILD activity, Dragonfly Pond.

Materials:
Provided by educator:
Per student: one copy of Student's Information
Per three students: scissors, masking tape, paste or glue, paper, one copy of each of "Land Use Cutouts," "Park Lake Maps"

Major Concepts:
- Human impact on watersheds
- Water quality
- Land use planning and its effect on a lake
- Preservation of natural areas
- Resource management

Objectives:
- Evaluate the effects of different imaginary land uses on Park Lake.
- Discuss and list five ways to reduce damages to Park Lake.
- List three ways that people can change their life-styles to reduce damages to water quality and to Park Lake.
- List three ways local businesses, industries and communities could change the way they do business to decrease their damaging effects on water quality and on Park Lake.

Educator's Information:

The major purpose of this activity is to encourage the students to wrestle with potentially conflicting land-use concerns in an effort to preserve Park Lake and its watershed. After the students reach agreement about where to place local land-uses, they will consider how their decisions affect the aquatic resources downstream. End the activity with consideration of the idea that the earth's aquatic resources are all interconnected, so all land use activities affect other things.

Student's Information:

Every human use of land and **water** affects plant, animal and human **habitats**. What humans do with the world's resources shows what is important to us and our **lifestyles**. The search for the "good life" and all of its conveniences produces mixed results for plants, wildlife and the environment. Some people see natural areas as little more than raw material for human use. Others believe the natural environment should be preserved regardless of human needs. Still others look for a balance between these outlooks. Very real differences of opinion exist between well-meaning people!

Given the extensive impact humans have on the earth, a major challenge we now face is how to be more responsible about this impact. We must develop the awareness, knowledge, skills and commitment necessary to encourage others to act responsibly when it comes to taking care of **watersheds** and the remaining natural areas. We must develop the necessary understanding to restore areas long disturbed by humans.

At the center of land use issues is the concept of growth. Growth in natural systems has inherent limits, imposed by a dynamic balance of energy between all parts of the system. Energy in natural systems is translated into food, water, shelter, space and survival. This means that natural systems are self-regulating. This capacity for self-regulation makes it possible for all natural members of an **ecosystem** to live in harmony. All life forms of any ecosystem must be considered. The **macroinvertebrates** in the water are just as necessary to a habitat as the plants and fish. It is this natural balance, with all its inherent and essential parts, that much of human land use has disturbed. Human activities often go beyond the natural limits of a setting.

The Lake Norman area is growing rapidly. Homeowners and industry are spreading out from our cities into the lake area. They seek undeveloped land to use and help our local economy by creating new jobs. This is good, but sometimes development conflicts with protecting the lake and the plants and animals living in and around the lake. This is where different people have different ideas about how to best use the land and water from Lake Norman and still ensure the lake is clean.

Think back to your visit to Duke Power State Park. We know Lake Norman provides water to many towns and cities for drinking, industry and **sewage** treatment. Lake Norman is also used for recreation and is home to a wide variety of plants and animals.

Humans have the ability to import energy sources that allow a system to exceed its natural limits–or to remove energy sources that are necessary for a system to stay in balance. For example, people can dam rivers to make lakes, like Lake Norman, to provide power, drinking water and **irrigation**. Water from Lake Norman can be used in factories, mills, sewage treatment and other industries that need large amounts of water to produce certain products. All of these activities could affect life in Lake Norman.

So how do we make land use decisions that will benefit the local economy and still protect our natural resources? The following activity shows how difficult the decision-making process can be.

McCafferty, Aquatic Entomology
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Instructions:

1. Prepare copies of the "Land Use Cutouts" and "Park Lake Map" for students. Explain that they will be responsible for arranging the pattern of land use within the Park Lake watershed to best protect this resource.

2. Divide the class into groups of three to five, with each group representing an interest group. Students will stay in these groups until the end of the activity. Interest groups are:

A. Farmers - want to clear and use land to produce food, livestock and lumber.

B. Highway department - wants to build access in the area to provide highways and fire, police and emergency medical services.

C. Permanent residents - want development, but not so much that their homes are affected by noise, traffic, **pollution**, etc.

D. Business interests - want to use the land for commerce and development (home builders, small business, etc.)

E. Public services - want to build and operate a **waste water treatment plant** in the area.

F. Adopt-a-State Park group - wants to help preserve additional land for the area park.

3. Pass out the "Land Use" and "Park Lake" worksheets. Have the students tape Park Lake Map together, cut out the land-use pieces and place them around the lake watershed upstream from the park boundary. Tell them that all of the land use pieces must be used, and none may be placed within the state park. The pieces can be cut smaller, but must not overlap. The students may also develop their own land uses.

4. Once the students have cut out the necessary materials and are ready to begin the process of making land use decisions, have them create a list of pros and cons for each land use. Guide the class discussion so they consider the consequences of each land use. Record these on the chalkboard.

The following are a few examples:

Natural Areas

PRO

- Provide outdoor recreation opportunities such as hiking and nature study
- Provide protection of natural communities and habitats, the watershed, and native **species**
- Bring tourist dollars into local economy as park visitors spend money at local businesses

CON

- Remove lands for possible development (i.e. agriculture, forestry, industry, etc.)

Farms

PRO

- Produce food
- Provide jobs
- Produce lumber and other wood products

CON

- Increase **soil erosion**
- Use chemicals (pesticides, herbicides, etc.) that may harm people and the environment
- Use fertilizers and produce animal wastes which increases nutrient load in the **aquatic** systems
- Sometimes destroy stream buffers, wetlands or other natural areas for fields or to harvest lumber

Homes

PRO

- Provide human shelter
- Provide jobs in construction and maintenance

CON

- Generate waste, sewage, and other pollution (i.e. used oil, lawn chemicals, etc.)
- Contribute to loss of natural areas (i.e. development and energy needs)

Waste Water Treatment Plant

PRO

- Provide for more development
- Provide treatment for waste water
- Provide jobs in construction, maintenance and operation of the plant

CON

- Discharge **effluent** containing chlorine and nutrients into the watershed
- Contribute to loss of natural areas (i.e. construction, maintenance and energy needs)

• Increase **runoff** from **impervious surfaces** (parking lot, roof, etc.) resulting from increased development

Restaurant

PRO

• Provide jobs

CON

• Contribute to loss of natural areas (i.e. energy needs)

• Increased runoff from impervious surfaces (parking lot, roof, etc.)

• Generate waste products

Highways

PRO

• Provide access to area and for emergency medical services

• Provide jobs in construction and maintenance of roads

CON

• Contribute to loss of natural areas (i.e. construction, maintenance and energy needs)

• Increase runoff due to impervious surfaces

• During construction, increase soil erosion

• Disrupt natural water flow and animal migration patterns

• Use herbicides that may harm people and the environment

Laundromat

PRO

• Provide jobs in construction and operation

CON

• Contribute to loss of natural areas (i.e. energy needs)

• May introduce significant amounts of polluted water into watershed

• Increase runoff due to impervious surfaces (parking lot, roof, etc.)

Gas Station

PRO

• Provide jobs in construction, maintenance and operation

CON

• Contribute to loss of natural areas (i.e. energy needs)

• Runoff may contain pollutants such as gasoline and oil

• Increase runoff due to impervious surfaces (parking lot, roof, etc.)

• May contaminate **groundwater** from leaking underground storage tanks

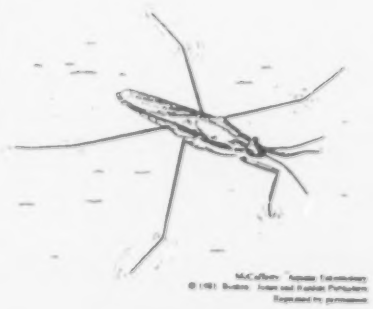
5. Have the students work in their teams long enough to begin serious debate over the land use decisions. Remind them that no land use can be excluded, the river corridor must be preserved, and everyone must reach consensus for each land use. Offer an opposing viewpoint should they need it. Have them lightly fasten the cut-outs to the map by placing small loops of tape on the back of them. This will allow the students to change their minds before they stick the cut-outs down permanently.

6. Invite each group to display and describe their work in progress. Encourage discussion of their choices.

7. Continue the discussion by asking more students to share their proposed plans. Again, be firm in discussing the consequences. Point out that shutting down the businesses or farms could negatively impact the economic base of the area.

8. Give the students additional time to work in their groups to come up with what they believe is the best possible land use plan. Be sensitive to their frustrations and display all the final landuse plans in the classroom for all to see and discuss. Analyze and discuss the merits of each of the approaches. Point out that although their solutions may not be perfect, they can reduce damage to the Park Lake watershed.

9. Display one of the groups' maps on the chalkboard. Next, draw "The Rest of Park Lake" connected to it. Label all the features as indicated.



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10. Ask the students to brainstorm possible problems that could be faced within each of these aquatic systems (Norwood Creek, Hicks Creek, and Lake Norman) as a result of the human activities around the Park Lake watershed. Note that all the pollutants dumped into the Park Lake watershed eventually flow downstream. Make inferences and predictions about the potential consequences of these activities. For instance, you could emphasize the wastewater from the laundromat. How will it be treated? Where? By whom? Where will it go? With what effects?

11. Ask the students to look again at all of the land uses in this activity. If they had been considering any of them as inherently bad, have them consider a different question. What could the people who are in charge of these various businesses do to reduce the damage to Park Lake? Have the activity end with a positive emphasis on solutions rather than problems and have them write these solutions on the board.

12. Have the students create a list of things which they personally can do to reduce the potentially damaging effects of their lifestyles on the "downstream" areas they may never have thought about. If possible, invite them to report periodically, throughout the school year, on their progress in carrying out these new practices. Consider with them the idea that all of the waters of the earth are interconnected and are in fact part of a single "Park Lake" watershed.

Suggested extensions:

1. Organize a "Stream Watch" group in your community. Stream Watch groups "adopt" a waterway, or portion of one, and act on its behalf. They take care of the waterway by monitoring water quality, providing educational programs, removing litter, etc. For more information on Stream Watch, contact:

Stream Watch Coordinator, Division of Water Resources, NC Department of Environment, Health and Natural Resources. PO Box 27687, Raleigh, NC 27611, (919) 733-4064

2. Collect newspaper articles for local water-related and landuse issues as a current events activity.

3. Learn more about environmental impact statements. Try to obtain actual statements about natural areas in your region. See what concerns are addressed in these documents.

4. Learn more about private organizations that work to protect natural resources. Examples include:

The North Carolina Environmental Defense Fund, 128 E. Hargett St., Suite #202, Raleigh, NC 27601

The North Carolina Nature Conservancy, Carr Mill Mall, Suite 223, Carrboro, NC 27510

The Catawba Lands Conservancy, 1614 Fountain View Charlotte, NC 28203

Find out what they do and how they do it.

5. Find out about zoning laws and landuse regulations in your area by contacting the following:

City/County:
Director of City/County Planning/Zoning

State:
Division of Environmental Management
PO Box 27687
Raleigh, NC 27611

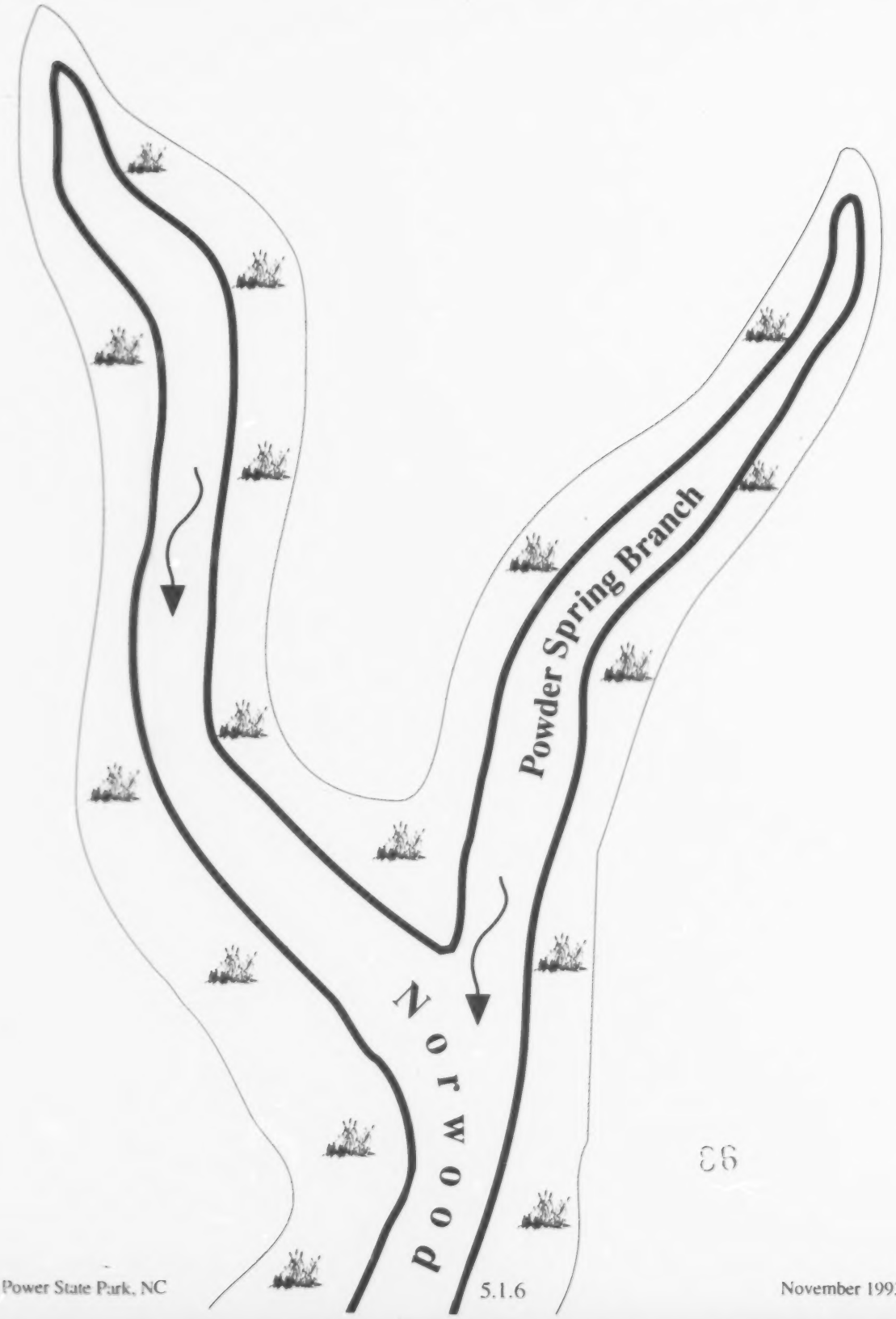
Would the plan your group proposed for the Park Lake watershed be allowed in your community?

6. Send a representative sample of the students land use plans to the park. (We would appreciate the feedback.)

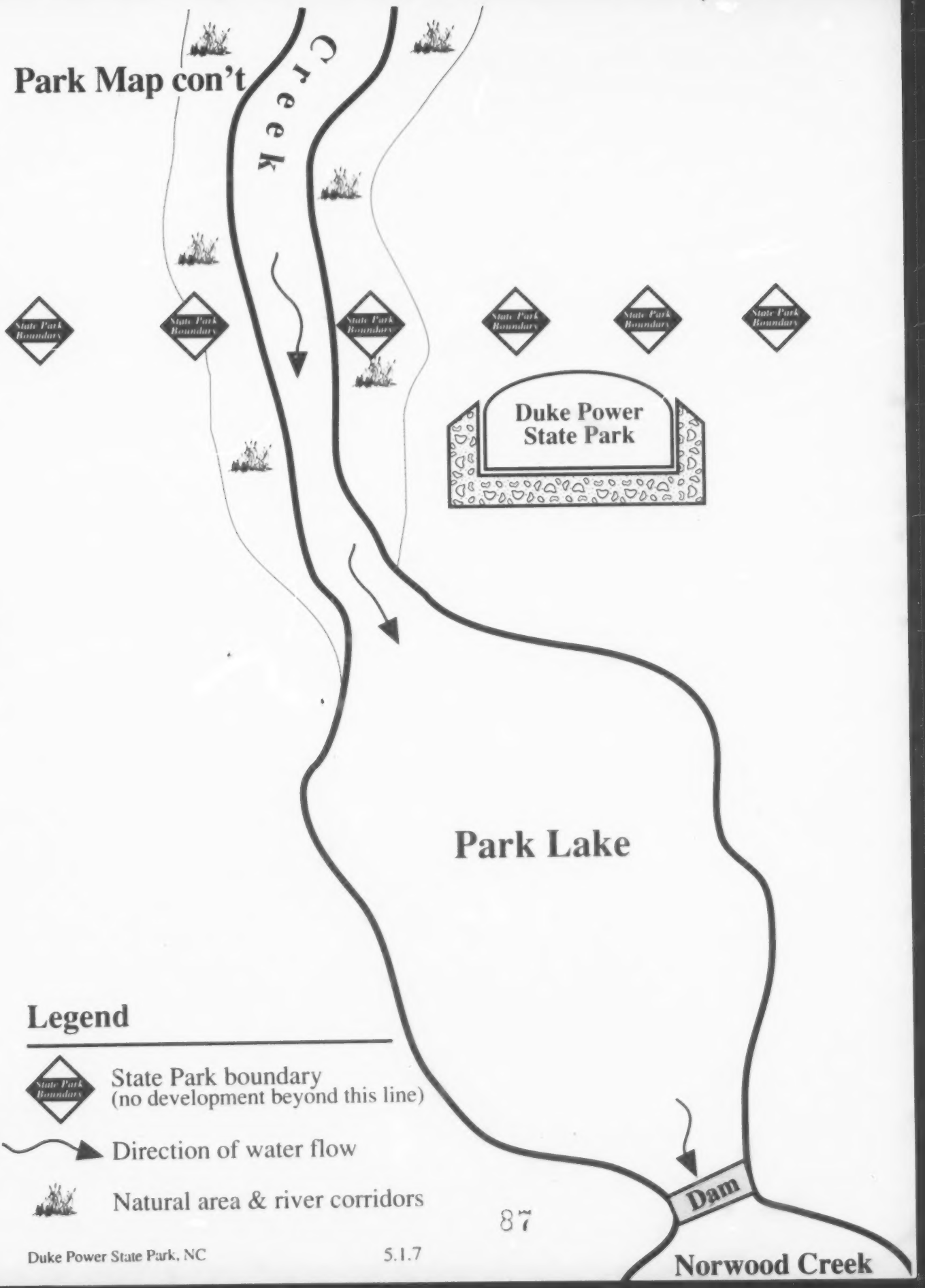
7. Write to the Iredell County Planning Board about any concerns you have with the water quality of Park Lake (the swimming lake) at Duke Power State Park or Iredell County at:

Planning Board, c/o Iredell County Planning Department, Attention: William Allison, PO Box 788, Statesville, NC 28677

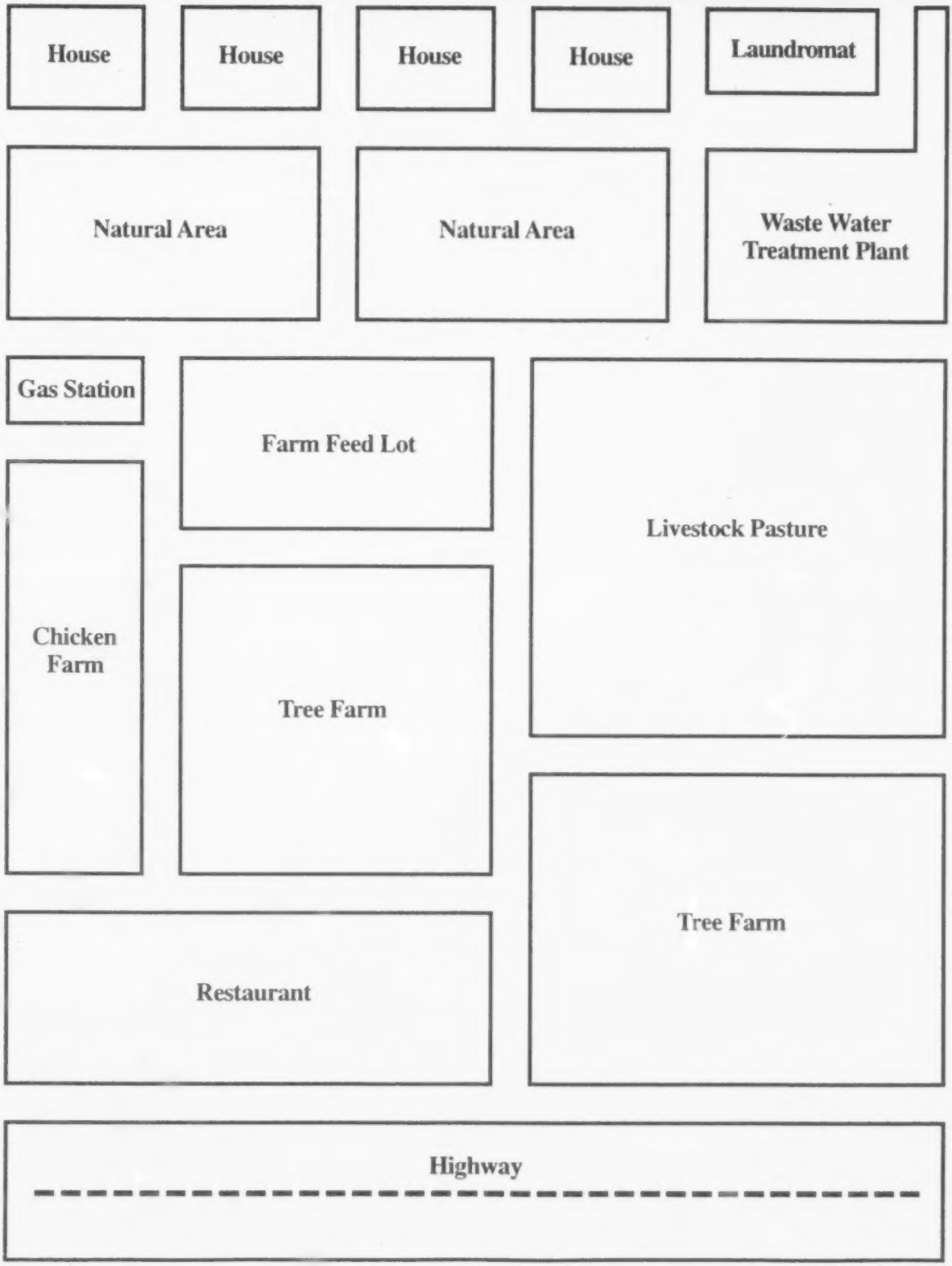
Park Lake Map



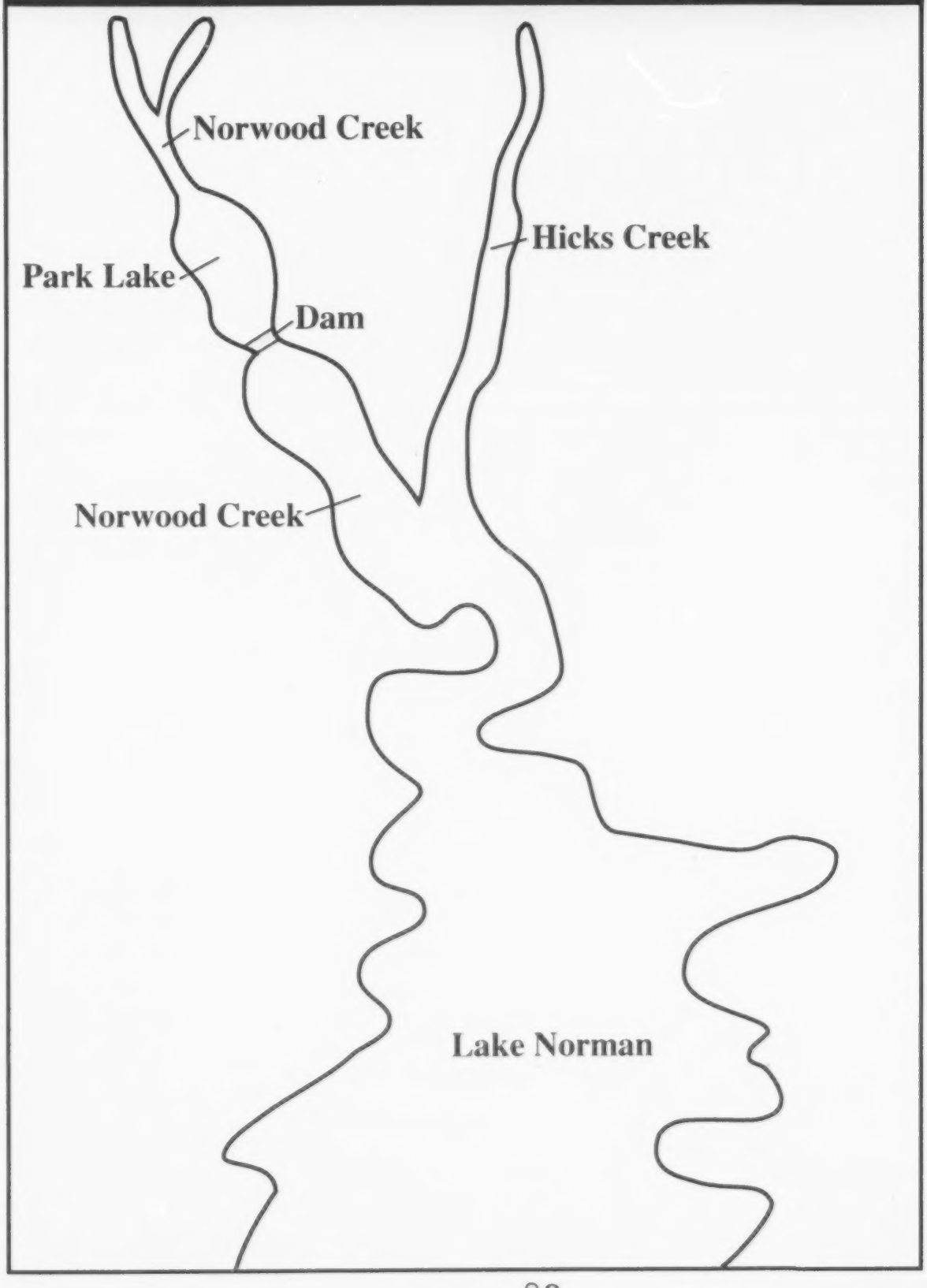
Park Map con't



Land Use Cutouts



The Rest of Park Lake



Post-Visit Activity #2 — Guilty or Innocent

Major Concepts:
- Water quality
- Environmental ethics

Learning Skills:
- Communicating
- Inferring and elaborating

Subject Areas:
- English Language Arts
- Social Studies
- * See **Activity Summary** for a Correlation with DPI objectives in these subject areas.

Location: Classroom

Group Size: 25 - 30

Time: 1 hour with additional time for poster or letter writing campaign

Credits: Guilty or Innocent is reprinted with slight adaptations with the permission of the National Wildlife Federation from the *Pollution: Problems & Solutions* issue of the *NatureScope* series.

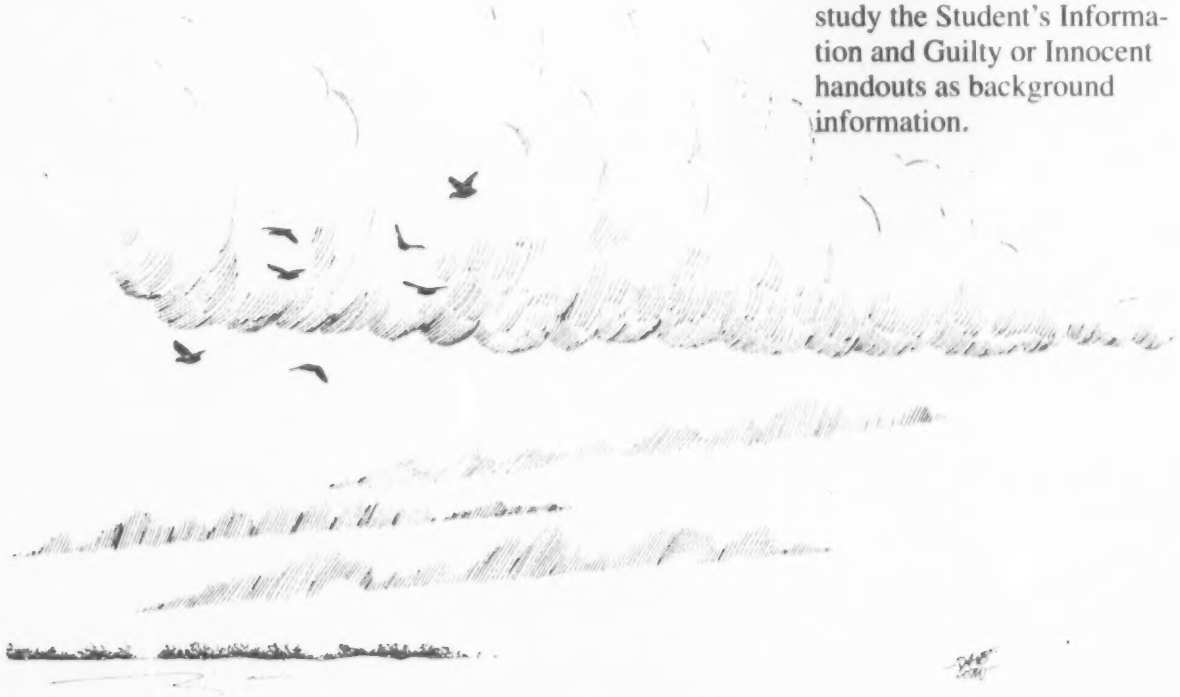
Materials:
Provided by educator:
Per student: one copy of the Guilty or Innocent handouts, posterboard, writing paper, pen, envelope, stamp
Per class: chalkboard or easel paper, crayons and magic markers

Objectives:

- Describe at least five ways people pollute water.
- Identify at least five things people can do to help prevent water pollution.

Educator's Information:

In this activity, the students will discuss ways water becomes polluted and learn various facts about water pollution. They will then read about the actions of fictitious characters and decide whether or not they are guilty of polluting water. Additionally, they will discuss ways they personally can reduce water pollution and create posters which raise awareness about what every individual can do to reduce water pollution. They should also be encouraged to write letters to lawmakers concerning pending legislation which is pro-environment. The teacher should read and study the Student's Information and Guilty or Innocent handouts as background information.



Instructions:

1. Begin the activity by asking the students to name some ways that water gets polluted.

2. Write their ideas on a chalkboard or piece of easel paper and tell them they'll be adding to the list later.

3. Pass out copies of the Guilty or Innocent handout, page 1, and explain that each of the facts on the page has something to do with water pollution. Have them read the page, and then go over any facts they didn't understand.

4. Next, pass out copies of Guilty or Innocent, page 2. The students will see that the page has a picture and short description of five different people. They should read each description and then use the facts on page 1 to decide whether the person is more likely to be guilty or innocent of polluting water.

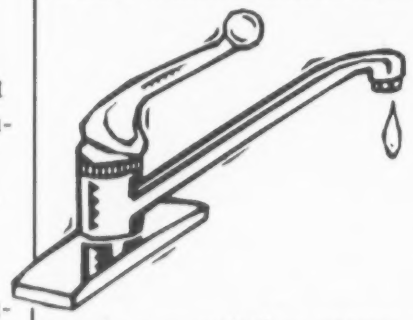
5. Tell the students to write "guilty" or "innocent" on the line following each character's description. Then, on the back of page 2, have them write a short explanation of why they think each person is guilty or innocent. Tell them to include the numbers of the facts they used to reach their answer.

6. When everyone is finished, go over page 2 with the students, using the answers on your answer sheet and the background information. Be sure to explain that some of the actions of the people on the page might not affect overall water quality very much by themselves. But if a lot of people in the area were doing the same things, the cumulative effect could be disastrous. Unfortunately, this is exactly what happens in many communities throughout the United States.

7. Next, discuss with the students the fact that, like the characters in the story, all of us are "guilty" of polluting water without knowing it. Every time we flush our toilets, wash our clothes, take showers, and do any number of things that require using water, we contribute to water pollution problems.

8. Ask the students if they'd like to add anything to their list of ways water gets polluted.

9. Point out that there is a lot people can do to reduce the amount of water pollution they create. Ask the students what kinds of things the characters on page 2 might do to reduce their effect on water quality. (Joe — use fewer and less-toxic pesticides, use natural insect predators to help control pest insects, make cows graze away from the stream. Leila — use collecting pans to catch liquids emptying from the car; take used motor oil and antifreeze to a collection center for recycling or to a hazardous waste collection center; soak up any spilled liquids with cat litter and then take the litter to a hazardous waste collection center. Lee — switch to nontoxic lawn care. Martha — periodically check the underground storage tank for leaks; upgrade the tank so it won't corrode. Amy — use detergents that don't contain phosphates.)



10. Have the students read Student's Information, then list the things they could do around their own homes to reduce water pollution. Discuss.

11. Ask students to find out which watershed or river basin they live in. Create a poster campaign for raising awareness among fellow schoolmates about what each of us can do to reduce water pollution in our community's watershed. Display the posters around the school

and see if area merchants will put the posters in their stores as well.

12. Find other ways to publicize what the class has done. Contact broadcast media, the city council, garden clubs, parent-teacher association, etc.

AND/OR

13. Find out what sort of legislation is pending concerning the environment or environmental issues in your watershed or river basin.

14. Write to your lawmakers and share your concerns about water quality. Encourage them to support legislation that will maintain or improve the water quality in your watershed or river basin.

Legislators

N.C. General Assembly
Raleigh, NC 27611

Senators

U.S. Senate
Washington, DC 20510

Governor

State Capitol
Raleigh, NC 27602

Congressmen

U.S. House of Representatives
Washington, DC 20515

Student's Information:

Environmental pollution is a global issue. Often individual citizens feel helpless given the scope of the problem. They can make a difference, however, just by educating themselves about what they can do around their homes and in their lifestyles to reduce environmental pollution and improve **water quality.**

Take a look at some common household pollutants which impact water quality.

Ruinous Runoff: Anything that's sprayed, dumped, or spilled on the ground may end up in waterways. Pesticides, chemical fertilizers, animal waste, and other compounds may flow directly into waterways or wash down storm drains, which usually empty into surface water. (In many cities in the U.S., storm drains don't empty directly into waterways. Instead, material that washes into them combines with wastewater from homes and businesses and flows to a **sewage** treatment plant for purification. During heavy storms, the wastewater can back up and overflow directly into surface water without being treated.) Many of the materials that get sprayed, dumped, or spilled on the ground can also soak into the soil and contaminate **groundwater.**

Car Care: A car engine may hold four to six quarts of oil. When this oil gets dumped down a storm drain, it can end up in a nearby waterway and create a slick that covers a huge area. Just a single quart of motor oil can contaminate up to two million gallons of drinking water. Other car products, including antifreeze, are also toxic and may poison aquatic animals if they get into waterways.

Wash It All Away: The stuff most people in the U.S. wash down their drains and flush down their toilets goes to a sewage treatment plant before it's released into rivers or other waterways. These plants can remove many of the pollutants in wastewater, including food and other organic waste. Some can even remove most of the phosphates in wastewater, but many cannot. Because of the problems they can cause, phosphates have been banned from use in detergents in some states. Equipment that can remove phosphates from wastewater is being installed in many sewage treatment plants.

Storage Problems: There are approximately five million underground storage tanks in the United States, and more than 200,000 of them may be leaking. These tanks are used to store gasoline, oil, chemical waste, and other hazardous liquids. Most of the tanks are made of steel, which can corrode, and they often develop leaks after about 20 years. Leaks in underground tanks and the pipes that lead to them are one of the most common sources of groundwater **pollution.**

Traffic Troubles: In most of the United States, cars are the major means of transportation. They are also one of the major causes of air pollution. Every day millions of people drive to and from work, school, church, shopping centers, etc., all the while emitting a gaseous pollutant known as nitrogen oxide into the air. When it rains, these highly acidic pollutants combine with water to produce a corrosive solvent known as "acid rain." The acid rain that falls to earth not only affects the plant life on earth but raises the acid level in lakes, rivers, and streams as well.

Electric Pollution: Most of the electricity people use in the U.S. comes from power plants that burn coal or oil. Burning these fossil fuels contributes to acid rain and other kinds of air pollution. The extraction of these fuels can harm natural areas and result in **runoff** problems. (When rain runs off land that's been disturbed by bulldozers and other equipment, it picks up dirt and silt and carries them into surface water. Once in the water, sediment can keep sunlight from reaching aquatic plants, can clog fish gills, and can smother bottom-dwelling organisms.) The more electricity we use, the more pollution we create.

Off the Streets: Oil, dirt, litter, and anything else that's on the streets washes into storm drains. In most areas of the country, these drains empty into a series of underground pipes that eventually dump directly into waterways.

Trashing the Water: When trash gets thrown overboard it can create an ugly mess — both in the water and on shore after it's washed up. Trash can also harm or even kill wildlife. For example, thousands of sea birds and marine mammals die each year after eating or becoming entangled in plastic debris floating in the ocean.

It is easy to understand that a crippled tanker leaking millions of gallons of crude oil into the ocean is polluting the water. But big industry cannot take all the blame. We are each responsible to some extent for all forms of pollution. In this activity you will discover some of the not-so-obvious ways people can pollute water every day without realizing it.

GUILTY OR INNOCENT?

PAGE 1

1. Rain and snowmelt that wash off the land may flow directly into streams, lakes, and other waterways. Or they may flow into storm drains, which, in most communities in the United States, connect the pipes that empty into waterways.

2. In most areas of the country, whatever goes down people's toilets and drains travels to a sewage treatment plant.

3. Gas stations store gasoline in underground tanks.

4. Thick, green lawns often get that way by being treated with chemical fertilizers and pesticides.

5. Sewage treatment plants treat wastewater to remove many of the pollutants in it, such as disease-causing organisms and food waste. Then they dump the treated water into rivers, streams, and other waterways.

6. Most sewage treatment plants can't remove all of the phosphates that are in wastewater.

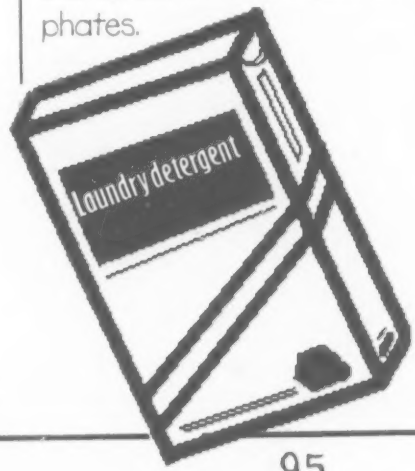
7. Gasoline storage tanks often develop leaks after about 30 years.

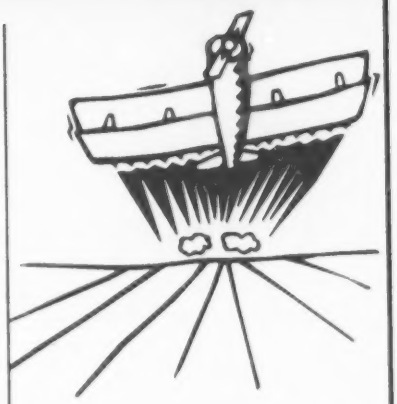
8. To repair or replace a leaking gasoline storage tank, someone must dig up the tank.

9. Fertilizers, road salt, animal waste, car fluids, and other materials that wash into waterways can poison aquatic plants and animals, decrease the amount of oxygen in the water, or create other problems.

10. When substances soak through the soil, they can contaminate groundwater.

11. Many powdered laundry soaps in the United States contain some phosphates.





12. Crops grown with a lot of pesticides often look "perfect."

13. Phosphates and other chemicals that end up in waterways can cause problems for aquatic organisms.

14. Pesticides that are used to kill insects and other pests can wash into waterways and poison fish and other creatures.

GUILTY OR INNOCENT?

PAGE 2

Two days ago, the Statesville water inspector discovered pollutants in Fourth Creek, the creek located east of town. A short time later she found contaminants in several private wells. Using the clues on page 1, can you figure out which of these Statesville area residents might have contributed to the problem?

JOE RAMOS

Joe Ramo's farm is one of the biggest in the Statesville area. And in the summer people come from all over to buy fruits and vegetables from Joe's produce stand. Everyone knows that Joe has some of the most beautiful produce around — it's almost always free of insect damage. And when kids come to the stand with their parents, they get a special treat: a chance to see Joe's cows with their calves in the field next to Fourth Creek.

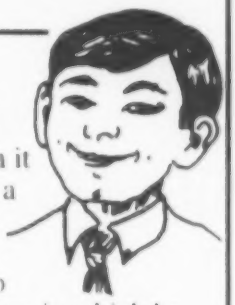
MARTHA STONE

Martha Stone's small gas station east of town has become a landmark in the Statesville area. Every day Martha is there selling gas, penny candy, and ice-cold sodas. And anyone who goes into the station is sure to get an earful of stories about what life in Statesville used to be like. First-time visitors to the station almost always get a tour of it, starting on the sidewalk above the underground storage tank. Here Martha shows people where she carved her initials and the year "1953" in the wet cement the day before the station opened.

LEILA KHALIL

Leila is a senior at South Iredell High School. A year ago she bought a car with money she'd saved from her part-time job, and since then she's learned to do most of the car's maintenance work herself. She changes her own oil, maintains the wiper fluid, and changes the antifreeze. After Leila works on her car she cleans up, pouring her used motor oil down the storm drain and hosing down her parent's driveway.

LEE AKIZA



When he started his lawn-care company five years ago, Lee Akiza had no idea it would be so successful. In a recent interview about his company, Lee said he was sure his success was due to his special training programs, in which he teaches his workers how best to apply fertilizers and weed killers. Mr. Akiza also said he's proudest of the thick, green grass that grows on the golf course at the Statesville Country Club, which his company takes care of.

AMY KAROWSKI

Amy Karowski is a full-time homemaker with three children. On weekends, Amy watches her kids play football, basketball, or baseball, depending on the time of year. Between games she spends a lot of time washing dirty uniforms! In fact, the clerk at the supermarket often teases Amy about the huge boxes of heavy-duty detergent she buys.

GUILTY OR INNOCENT? ANSWER SHEET

(Fact numbers are listed in parentheses.)

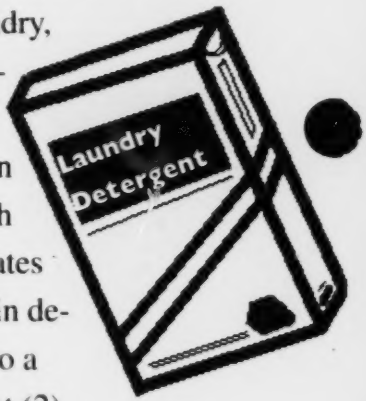
Joe Ramos — guilty. To grow "perfect" fruit and vegetables, Joe most likely uses lots of pesticides (12). Rain or snowmelt may wash these chemicals into waterways (1,9,14), or pesticides may soak into the soil and contaminate groundwater (10). Also, Joe keeps cows in a field right next to Fourth Creek and the cows' waste may wash into the creek (9).

Leila Khalil— guilty. When Leila dumps her used motor oil down the storm drain, it eventually flows into a waterway (1). Once in the water, the oil can cause problems (9). In addition, when Leila hoses down her parents' driveway, the water may carry the waste into storm drains and then into waterways (1,9).

Lee Akiza— guilty. Lee most likely uses chemical fertilizers and pesticides to make lawns become thick and green (4). Rain or snowmelt may them wash these chemicals into waterways (1,9,14), or the chemicals may soak into the soil and contaminate groundwater (10).

Martha Stone — guilty. Martha Stone's gas station has an underground gasoline storage tank (3). This tank could be leaking gasoline since it is close to 40 years old and has never been replaced or repaired in all that time (7,8, and the "1953" written in the cement that's mentioned in the description). If gasoline is leaking from the tank, it could taint groundwater (10).

Amy Karowski — guilty. When Amy does her family's laundry, she uses powdered detergent (the boxes of detergent mentioned in the description), which could contain phosphates (11). The phosphates in detergent end up going to a sewage treatment plant (2), which probably isn't able to remove all of them from the water (6). So some of the phosphates end up in waterways (5), where they can cause problems (13). The chemicals in many other household products, such as paint thinners, oven cleaners, and drain cleaners, can also contribute to water pollution problems.



Post-Visit Activity #3 — Pollution Dilution

Major Concepts:
- Water pollution
- Watershed
- Point pollution
- Non-point pollution

Learning Skills:
- Interpreting data, communicating
- Graphing
- Organizing and analyzing information

Subject Areas:
- Science
- English Language Arts
- Mathematics
- * See Activity Summary for a Correlation with DPI objectives in these subject areas.

Location: Classroom

Group Size: 30 or smaller

Time: 1 - 1 1/2 hours

Materials:
Provided by the educator:
Per class: Nine different colors of construction paper (2 sheets of each), magic marker, scissors
Per team: one each of Pollution Graph, tape (or glue), plastic container for simulated water sample, Fact Sheet for Lake _____, Water Sample Analysis Sheet
Per student: one copy each of Types of Pollution sheet and Student's Information

Credits: "Deadly Waters," *Aquatic Guide* -- 1987,1992, Western Regional Environmental Education Council. Adapted with permission from Project WILD. In North Carolina, Project WILD is a part of the N.C. WILD environmental education program. For more information on N.C. WILD, contact the Conservation Education Division, NC Wildlife Resources Commission, 512 N. Salisbury St., Raleigh, NC 27604-1188.

Objectives:

- List at least four major types of aquatic pollution.
- Given a list of pollutants in a water sample and a description of land use in a watershed, make inferences on the probable causes of the pollution in the sample.
- Predict the potential effects of a variety of aquatic pollutants on wildlife and people.

Educator's Information:

In this activity, the students will become familiar with the major types of aquatic pollution, and predict the potential effects of a variety of aquatic pollutants on wildlife and people. Each team will receive a small container with different amounts of colored paper squares. The container represents a water sample from an imaginary lake; the paper squares represent different types and amounts of water pollutants in their lake. The students will graph the data from their sample and use a fact sheet about their lake to help them make inferences about the probable causes and severity of pollution in their lake. Using the Types of Pollution sheet and Student's Information, the teams will predict the potential effects of specific types of water pollutants on people and wildlife. The teacher should read and study the Student's Information and Types of Pollution sheet as background information.

BEST COPY AVAILABLE

Instructions:

1. First, prepare the simulated water samples for the student teams. It is recommended that each team have two to four members to ensure a high level of student participation. These instructions contain directions on preparing water samples for *four* imaginary lakes. You could make two water samples for each lake so that you would have a total of eight water samples (eight student teams). Although the samples for a given lake will be identical, the two student teams may differ in their interpretation of the data. This would be an excellent opportunity to demonstrate the probabilistic nature of science.

2. Using nine different colors of construction paper, cut out one-half inch squares, so that you have the number of squares per color as listed below. *Remember to double the numbers if you are preparing two samples for each imaginary lake.* The colors represent the categories of water pollution found on the Types of Pollution sheet. If you need to substitute a different color for one of the colors below, please correct the color name on the Types of Pollution sheet before photocopying it for your students.

Green: 23 (Double = 46)

Brown: 19 (Double = 38)

Yellow: 16 (Double = 32)

Pink: 17 (Double = 34)

Black: 15 (Double = 30)

Light Blue: 12 (Double = 24)

Red: 8 (Double = 16)

Orange: 15 (Double = 30)

Dark Blue: 26 (Double = 52)

3. The "recipe" for the water sample from each imaginary lake is given below. If you are making two water samples for each lake, you will need a total of eight containers. You could cut old two-liter drink bottles in half and use the bottom half as a container. Label each container with the name of one of the lakes. Place the colored paper squares in each container as called for in the "recipe."

Lake Ipecac: Dark Blue - 12, Yellow - 2, Green - 7, Pink - 5, Black - 3, Brown - 2, Light Blue - 4, Red - 1, Orange - 3.

Lake Chickamonga: Yellow - 6, Dark Blue - 5, Green- 4, Brown - 4, Pink - 4, Black - 3, Light Blue - 2, Red - 1, Orange - 4.

Lake Lapihiho: Green - 7, Brown - 11, Yellow - 4, Pink - 4, Black - 3, Dark Blue - 4, Light Blue - 2, Red - 2, Orange - 5.

Lake Rockameenie: Black - 6, Green - 5, Brown - 2, Yellow - 4, Pink - 4, Dark Blue - 5, Light Blue - 4, Red - 4, Orange - 3.

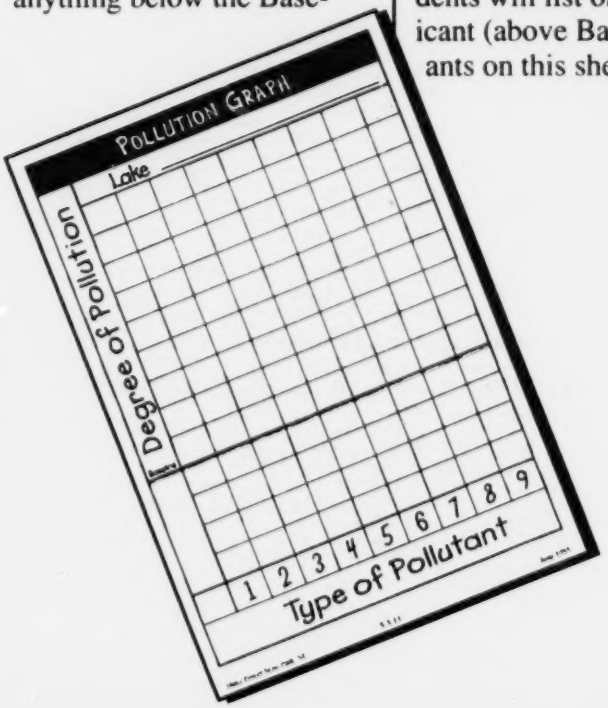
4. Make one copy of the Student's Information and Types of Pollution sheet for each student. Make one copy *per team* of the fact sheet for their lake, the Water Sample Analysis Sheet, and the Pollution Graph.

5. To begin the activity, ask students to call out examples of different types of water pollution. List their examples on the board or overhead. Then give each student a copy of the Types of Pollution sheet. Have the students compare their examples with the pollution types listed on the sheet. Could all the students' examples be placed under one of the categories on the sheet? Are there any new terms, or types of pollution, that are unfamiliar to the students? Also read and discuss the Student's Information sheet so that students are prepared to begin analyzing their simulated water samples.

6. Divide the students into research teams. Give each team a simulated water sample, Pollution Graph, and tape (or glue). Explain that the different squares represent different types of pollution in their water sample. The students should use the Types of Pollution sheets to match the colored squares with the different types of pollution. Explain the graph, emphasizing that the numbers along the bottom correspond to the numbered pollutants on the Types of Pollution sheet.

7. Instruct the students to remove the paper squares from their water sample and glue or tape them in the appropriate location on the graph. The graph will provide a good visual representation of the whole array of pollutants in their lake. Explain that anything below the Baseline on the graph represents an acceptable level of pollution, not likely to be dangerous to humans or wildlife. (It is nearly impossible to have perfectly clean water!) However, the fact that a pollutant is present should cause some concern. The below Baseline pollutants should be carefully monitored over time to make sure they don't become a problem in the future.

8. When each team has finished their graph, give them the Fact Sheet for their lake and a Water Sample Analysis Sheet. The Fact Sheet will describe their watershed and the types of human activities that occur there. The team should use the Water Sample Analysis Sheet as a graphic organizer to help them organize their inferences and predictions. An example is provided on the sheet. The students will list only the significant (above Baseline) pollutants on this sheet.



9. When the teams are ready, ask them to share their findings with the class. Discuss the similarities and differences between the four lakes. Why did the lake with the largest city, the most campgrounds, and the most hotels in its watershed (Lake Rockameenie) have less pollution than some of the others? Did they consider the size of the lakes and the dilution factor? What pollutants would be likely to cause the *most* damage to wildlife, wildlife habitat, and people? Give examples and discuss the kinds of damage that could be caused. How could the pollution in each lake be prevented? If two teams analyzed the same lake, compare their presentations. Were their inferences and predictions exactly the same? Why or why not? Is it possible that there could be several logical causes or sources for one type of pollution? What further testing could be done to find the actual cause?

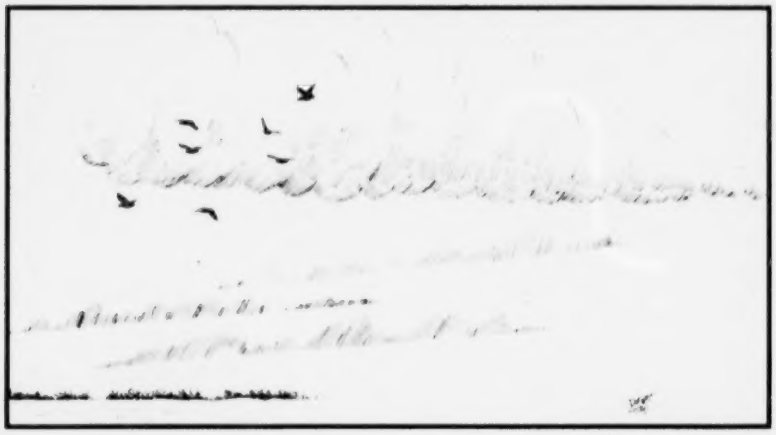
Student's Information:

All the water that has ever been available to our planet is on, or in, the earth right now. On the entire planet there are 326 million cubic miles of water. If the Earth were the size of a beach ball, 28 inches in diameter, all of the water on the planet would fill less than a cup. Most of the water in that cup would be salt water. Less than one drop would represent the freshwater contained in rivers and lakes!

Our supply of freshwater is fragile. Yet every day water is being damaged by **pollution** and most of the pollution is caused by people and their activities. There are many different types of pollution. Several major kinds are listed on the Types of Pollution sheet that you will be using with this activity.

Scientists divide water pollution into two major categories: point and non-point. **Point pollution** comes from a localized source and is fairly easy to pinpoint. An example would be a specific type of chemical that is being used or made by a factory. The factory may be the only source of that particular chemical in the watershed. If we found this chemical in the water, it would be very likely that the factory was the cause. We could prevent further pollution from this chemical by ordering the factory to stop discharging it into the water.

Non-point pollution is harder to pinpoint. Non-point pollution enters the water from a variety of sources that may be hard to identify. For example, rain can wash motor oil leaking from cars in many parking lots into storm drains where the oil will enter the city's water supply. In this case, it would be impossible to pinpoint all the sources of motor oil in the watershed. Non-point pollution is harder to manage than point pollution.



When significant amounts of water pollution are discovered in a city's water supply, scientists and law enforcement officials work together to find the cause. The person or persons responsible for the pollution must pay a fine for the damage done to other people and to aquatic wildlife. It takes a lot of detective work to find the causes of water pollution. Sometimes the actual cause is never found.

In this activity, you will work with other students to analyze a water sample from an imaginary lake. Your teacher will give your team a water sample along with a fact sheet that describes the watershed surrounding your lake. You and your team will work together to identify the kinds and amounts of water pollutants in your sample. Then you will use your fact sheet and your detective abilities to suggest possible causes of the pollution in your lake. It could be from point sources or non-point sources. Your teacher will give you a Water Sample Analysis Sheet which will help your team organize your clues. Finally you will present your analysis to the class. You will include ways that you think the water pollution in your lake could affect people and wildlife. Good luck!

Fact Sheet for Lake Ipecac

Size: Small, normally holds 40 billion gallons of water. Has 100 miles of shoreline.

Number of counties in watershed: Four

City wastewater treatment plants discharging into lake: Four

Industry in watershed with own wastewater treatment facilities discharging into lake:

- machinery company
- oil company
- trucking company
- hosiery mill
- chemical company
- fruit product company
- clothing industry
- chainsaw manufacturer

Development on lake:

- 80 percent of shoreline built up, mostly with homes using septic systems.
- Two medium-size cities and several medium-size towns in watershed.
- Several shopping centers in watershed.
- One private campground on lake with its own wastewater treatment facility.
- One public beach with septic system.
- Five large motels with own wastewater treatment facilities.

Recreational Use: Used for boating, fishing, and swimming

Marinas on lake: Five

Agriculture: Little agriculture in watershed

Fact Sheet for Lake Chickamonga

Size: Large, normally holds 200 billion gallons of water. Has 480 miles of shoreline.

Number of counties in watershed: Six

City wastewater treatment plants discharging into lake: Three

Industry in watershed with own wastewater treatment facilities discharging into lake:

- large paper mill
- steel corporation
- furniture factory

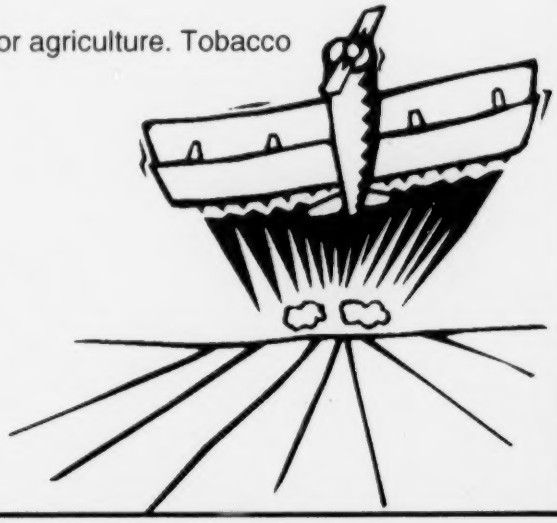
Development on lake:

- 40 percent of shoreline built up, primarily with homes using septic systems. Many homeowners are there on weekends only.
- Two small cities and several small towns in watershed.
- A few shopping centers in watershed.
- Five private campgrounds on lake with septic systems.
- No public beaches on lake.
- Four large motels with own wastewater treatment facilities in watershed.

Recreational Use: Used extensively on weekends for boating, swimming, and fishing.

Marinas on lake: Eight

Agriculture: Much land in watershed used for agriculture. Tobacco is primary crop.



Fact Sheet for Lake Lapihiho

Size: Small, normally holds 35 billion gallons of water. Has 95 miles of shoreline.

Number of counties in watershed: Three

Agriculture: Much farming upstream of the lake — chicken farms, livestock, and thousands of acres of corn crops.

City wastewater treatment plants discharging into lake: One

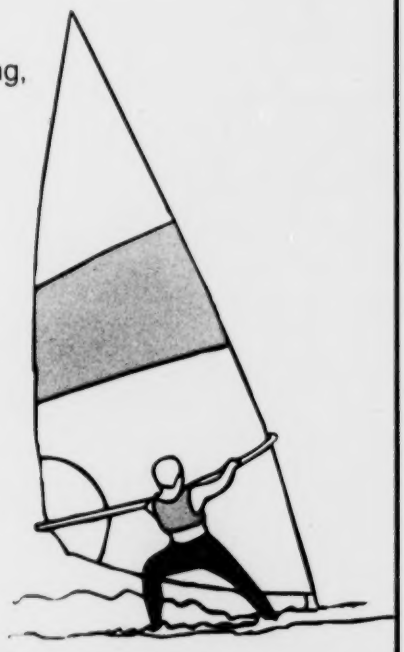
Industry in watershed with own wastewater treatment facilities discharging into lake: fiberboard industry

Development on lake:

- 30 percent of shoreline built up, mostly with homes using septic systems.
- One medium-size city and several small towns in watershed.
- Several shopping centers in watershed.
- Two public campgrounds on lake with septic systems.
- One public beach on lake with septic system.
- Three motels with own wastewater treatment facilities in watershed.
- One rest home with on-site wastewater treatment plant.
- One race track with on-site wastewater treatment plant.

Recreational Use: Used extensively for boating, swimming, and fishing. Heavy day-use.

Marinas on lake: Three



Fact Sheet for Lake Rockameenie

Size: Very large, normally holds 300 billion gallons of water. Has 500 miles of shoreline.

Number of counties in the watershed: Eight

City waste water treatment plants discharging into lake: Six

Industry in watershed with own wastewater treatment facilities discharging into lake:

- foam products industry
- large food processing plant
- leather tannery
- yarn mill

Development on lake:

- 65 percent of shoreline built up, mostly with homes using septic systems. Many residents live there year-round.
- One very large city, one medium-size city, and several medium-size towns in watershed.
- Several shopping centers in watershed.
- 10 large privately-owned public campgrounds on lake with own wastewater treatment facilities discharging into lake.
- Two public beaches on lake with septic system.
- 10 motels with own wastewater treatment facilities in watershed.

Recreational Use: Used extensively for boating, swimming, and fishing. Heavy day-use.

Marinas on lake: 15

Agriculture: Not extensive.

Other:

- Rock quarry in watershed.
- 20 percent of watershed involved in timber harvesting.
- Coal-fired steam plant on lake which burns 20,000 tons of coal a day and uses lake water as a cooling agent.

WATER SAMPLE ANALYSIS SHEET

LAKE _____

IDENTIFY: Significant Types of Pollutants (Above Baseline)	INFER: Possible Sources	PREDICT: Potential Effects on Wildlife and People (social, economic, health)
Example: Petroleum	• *Run-off from streets* • *Oil Company*	• *Fish die* • *Money lost to local bait shops that sell to fishermen*

TYPES OF POLLUTION

1. DOMESTIC SEWAGE Color: Green

Human wastes that are not properly treated at a **wastewater treatment plant** and then released into the water supply may contain harmful bacteria and viruses. Typhoid fever, polio, cholera, dysentery (diarrhea), hepatitis, flu and common cold germs are examples of diseases caused by bacteria and viruses in contaminated water. The main source of this problem is sewage getting into the water. Sewage can be accidentally discharged from **septic systems** or wastewater treatment plants. People can come into contact with these microorganisms by drinking the polluted water or through swimming, fishing, or eating shellfish in polluted waters.

2. FERTILIZERS & ANIMAL WASTES Color: Brown

The major source of pollution from agriculture comes from surplus fertilizers in the **runoff**. Fertilizers contain nitrogen and phosphorous that can cause large amounts of **algae** to grow. The large algae blooms cover the water's surface. The algae die after they have used all of the nutrients. Once dead, they sink to the bottom where bacteria feed on them. As they feed on the dead algae, bacterial populations can become so large they use up most of the oxygen in the water. When this happens, many **aquatic** animals that need oxygen die. This deadly process is called **eutrophication**.

Another type of fertilizer, animal waste, also pollutes the water. Unexpected flooding of barnyards or stock pens (used for raising cattle and other animals) can increase the toxic effects of animal waste in water. Animal wastes also act as a fertilizer and can cause algae blooms just as chemical fertilizers do.

3. INDUSTRIAL ORGANIC WASTE Color: Yellow

Food processing plants, paper mill plants, leather tanning factories, and other industries release **organic** wastes that bacteria consume. Organic materials come from once-living plants and animals. If too much waste is released, the bacterial populations increase and use up the oxygen in the water. Fish die if too much oxygen is consumed by decomposing organic matter.

4. SEDIMENTS Color: Pink

Particles of soils, sand, **silt**, clay and minerals wash from land and paved areas into creeks and tributaries. In large quantities, these natural materials can be considered a pollutant. Construction projects often contribute large amounts of **sediment**. Certain lumbering and farming practices affect sediments in runoff. Sediments may fill stream channels and harbors that later require dredging. Sediments suffocate fish and shellfish populations by covering the fish nests and clogging the gills of bottom fish and shellfish.

5. PETROLEUM PRODUCTS Color: Black

Oil and other petroleum products like gasoline and kerosene can find their way into water from ships, oil drilling rigs, oil refineries, gas stations, and streets. Oil spills kill aquatic life (fish, birds, shellfish, and vegetation). Birds are unable to fly when oil coats their feathers. Shellfish and small fish are poisoned. If it is washed on the beach, the oil requires much labor to clean up. Fuel oil, gasoline, and kerosene may leak into groundwater through damaged underground storage tanks.

6. INDUSTRIAL CHEMICALS Color: Dark Blue

Detergents, heavy metals, and many man-made industrial chemicals are released into waterways. They often come from manufacturing and mining industries, oil field operations, and other sources. These chemicals interfere with natural stream purification and many are toxic to fish and harmful to humans. They cause taste and odor problems and often can not be treated effectively. Some are very poisonous in small amounts. They also corrode expensive water treatment equipment and increase the cost of boat maintenance.

7. ACID PRECIPITATION Color: Light Blue

Aquatic animals and plants are adjusted to a rather narrow range of **pH** levels. pH is a measure of the acidity of a solution. When water becomes too acidic, due to industrial chemical pollution or **acid rain**, fish and other **organisms** die. Acid rain is caused by car exhaust and smoke from coal-fired power plants. The smoke from an erupting volcano can also cause acid rain.

8. HEATED OR COOLED WATER Color: Red

Heat reduces the ability of water to dissolve oxygen. Electric power plants use large amounts of water in the steam turbines. The heated water is often returned to streams, lagoons, or reservoirs. With less oxygen in the water, fish and other aquatic life can be harmed. Water temperatures that are much lower than normal can also cause **habitat** damage. Deep dams often let extra water flow downstream. When the water comes from the bottom of the dam, it is much colder than normal.

9. PESTICIDES, HERBICIDES, FUNGICIDES Color: Orange

Agricultural chemicals designed to kill or limit the growth of organisms are a common form of pollution. These products are used to limit the negative effects of undesirable species (i.e. weeds, insects, fungi) on agricultural crop production. They are also used on golf courses and in people's yards to get rid of weeds. Irrigation, **groundwater** flow, and natural runoff bring these toxic substances to rivers, streams, lakes where they can kill aquatic plants and animals. Some of these chemicals are also known to cause cancer in humans.

POLLUTION GRAPH

Lake _____

Degree of Pollution

Baseline

1	2	3	4	5	6	7	8	9

Type of Pollutant

VOCABULARY

Acid Rain - Rain, or other precipitation, with a pH of less than 5.6; results from atmospheric moisture mixing with sulphur and nitrogen oxides emitted from the burning of fossil fuels; may cause damage to buildings, car finishes, crops, forests, and aquatic life.

Acidic - Having a pH less than 7; the chemical state of water or other substance in which the hydrogen (H+) ions exceed the hydroxyl (OH-) ions. For example, a car's battery acid has a pH of 1. See pH.

Algae - Simple, one-celled or many-celled plants, capable of photosynthesis. They are usually aquatic and have no true root, stem or leaf.

Algae bloom - A heavy growth of algae in and on a body of water; usually results from high nitrate and phosphate concentrations entering water bodies from farm fertilizers and detergents; phosphates are also naturally occurring in rock formations.

Anatomy - The branch of biology that deals with the structure of plants and animals.

Aquatic - Living or growing in water.

Aquatic index - The relative health of a water body. It is based on the tolerance or sensitivity of a macroinvertebrate to changes in water quality. It is calculated using a simple formula.

Basic - Having a pH greater than 7; the chemical state of water or other substance in which the hydroxyl (OH-) ions exceed the hydrogen (H+) ions. For example, soap has a pH of 10. See pH.

Biology - The science that deals with the origin, history, physical characteristics, life processes and habits of plants and animals.

Classification - The grouping of organisms into categories based on shared characteristics or traits. For example, any animal that has feathers is considered a bird and placed in the Class Aves. Furthermore, if the bird has its eyes in front rather than on the side of its head, it is a member of the Order Strigiformes (the owls).

Detritus - Dead organic matter, such as fallen leaves, twigs and other plant and animal material, which exists in any ecosystem.

Dichotomous - Divided into two parts, groups or classes, such as a dichotomous key. Using a dichotomous key, one can identify an unknown organism by following the one branch of each pair that best describes the organism.

Distribution - The act of scattering or spreading out; the geographic range of an organism.

Dissolved oxygen (DO) - The amount of oxygen gas molecules dissolved in water. Fish and other aquatic animals depend on DO to breathe.

Ecology - The science of the relationships between organisms and their environments.

Ecosystem - Plants, animals and their physical surroundings which interact with environmental conditions, such as temperature and rainfall, forming an interdependent system.

Effluent - A liquid flowing out. The outflow of a sewer, septic tank, etc.

Erosion - The removal or wearing away of soil or rock by water, wind, or other forces or processes.

Eutrophication - Naturally occurring changes that take place after a water body receives inputs of nutrients, mostly nitrates and phosphates, from erosion and runoff of surrounding lands; this process can be accelerated by human activities.

Food chain - The transfer of energy and material through a series of organisms as each one is fed upon by the next.

Food web - The interlocking pattern of food chains which exist in an ecosystem.

Genus - The taxonomic category located between species and family.

Groundwater - Water that fills the spaces between rocks and soil particles underground. Groundwater is replenished when rainwater trickles through the soil. Surface water, such as lakes and rivers, is often replenished by groundwater.

Habitat - The environmental conditions of an area where a plant or animal naturally grows or lives; its environment.

Impervious surface - A surface that doesn't absorb water, such as a paved parking lot.

Indicator species - An organism whose presence or absence in a particular environment can be used to determine the health of that particular environment.

Insect - Any animal in the Class Insecta. It has a head, thorax, abdomen and three pairs of legs on the thorax. As adults they usually have one or two pairs of wings attached to the thorax as well.

Irrigation - The pumping of water from ponds, lakes or rivers through pipes or canals to supply crops or livestock with water during periods of dry weather.

Key - An ordered list of significant characteristics of a group of organisms used to identify unknown species.

Larva - (larvae, plural) The immature form of an animal that changes structurally when it becomes an adult, usually by complex metamorphosis.

Lifestyle - A way of life, including attitudes, values and priorities.

Macroinvertebrate - Macro means "large", invertebrate means "without a backbone." An invertebrate usually large enough to be seen without the aid of magnification.

Metamorphosis - Meta means "change", morphe means "form". A change in form, structure or function as a result of development. A physical transformation undergone by various animals during development from the larval stage to the adult form. For example, through metamorphosis, a hellgrammite (larval form) becomes a Dobsonfly (adult form). The change from a tadpole (larval form) to a frog (adult form) is another example of metamorphosis.

Mussel - Any of the various freshwater or saltwater bivalves (meaning the two shells); held together by a strong muscle.

Nonpoint pollution - Pollution that cannot be traced to a specific point, because it comes from many individual places or a widespread area (e.g., urban and agricultural runoff).

Nymph - The young of an insect that undergoes incomplete metamorphosis, differing from the adult primarily in size and structural proportions (i.e. wings).

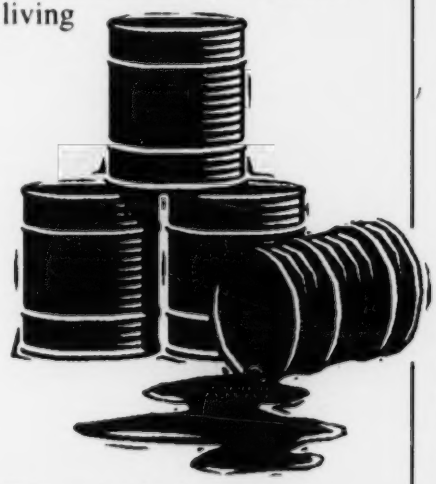
Organism - A living thing. Examples include plants and animals.

pH - potential of hydrogen. A measure that indicates the relative acidity or alkalinity of a substance. The pH scale is a logarithmic scale ranging from 0 (most acidic) to 14 (most basic), with a pH of 7 being neutral.

Photosynthesis - The chemical process carried on by green plants in which the cells containing chlorophyll use light energy to produce glucose (a plant food) from carbon dioxide and water; oxygen is released as a by-product.

Point pollution - Pollution that can be traced to a single point source, such as a pipe or culvert (e.g., industrial and wastewater treatment plant discharges).

Pollution - A human-caused change in the physical, chemical or biological conditions of the environment that creates an undesirable effect on living things.



River basin - The watershed of an entire river. It encompasses the many smaller watersheds of the river's tributaries or branches.

Runoff - Rain, melted snow and other materials that drain or flow off surfaces such as city streets, roofs, suburban lawns and agricultural land.

Sediment - Deposits of soil or organic matter which were suspended in water and then settled to the bottom. It is often deposited in the water by runoff.

Septic system - A domestic wastewater treatment system into which wastes are piped directly from the home into the ground; consists of a septic tank and drainfield; wastewater is exposed to bacteria that decompose the organic waste; dead bacteria and sediment settle to the bottom of the tank, and treated effluent flows out into the ground through drainage pipes.

Sewage - Liquid and solid waste mixed with water.

Silt - A sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

Soil - A collection of organic and inorganic particles, mainly composed of clay, silt, sand and gravel.

- clay - less than 1/256 of a millimeter (mm) in diameter
- silt - between 1/256 and 1/16 of a mm in diameter
- sand - between 1/16 and 2 mm in diameter
- gravel - over 2 mm in diameter

Species - The taxonomic category following genus which consists of similar organisms that can mate and produce fertile offspring.

Taxonomy - The branch of biology dealing with classifying organisms based on some common factor into naturally related groups.

Thermal stratification - The process during which waters of different temperatures form separate layers in a body of water with the lighter, warmer water floating on top of the denser, cooler water.

Tributary - A stream or river flowing into a larger stream, river or lake. For example, in the park lake watershed, Powder Spring Branch is a tributary of Norwood Creek.

Volume - A quantity, bulk, mass or amount. The amount of space occupied in three dimensions.

Wastewater treatment plant - A facility where household, business and industrial sewage are treated to remove harmful bacteria and chemicals.

Water - A transparent, odorless, tasteless liquid compound of hydrogen and oxygen (H20) which occurs on the earth's surface as oceans, lakes, rivers, etc.

Water quality - A way of determining or measuring certain characteristics of water.

Watershed - The total land area that drains directly into a particular r or lake.

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SCHEDULING WORKSHEET

For office use only:
Date request received_____ Request received by_____

1) Name of group (school) _____

2) Contact person _____ _____
name phone (work) (home)

_____
address

3) Day/date/time of requested program _____

4) Program desired and program length _____

5) Meeting place _____

6) Time of arrival at park _____ Time of departure from park _____

7) Number of students _____ Age range (grade) _____

8) Number of chaperones _____

9) Areas of special emphasis _____

10) Special considerations of group (e.g. allergies, health concerns, physical limitations)_____
_____

11) Have you or your group participated in park programs before? If yes, please indicate previous programs attended: _____
_____
If no, mail the contact person an Educator's Guide.

12) Are parental permission forms required? _____ If yes, please use the Parental Permission form on page 8.2.

I, _____, have read the entire Environmental Education Learning Experience and understand and agree to all the conditions within it.

Return to: Duke Power State Park
Route 2, Box 224 - M
Troutman, NC 28166

PARENTAL PERMISSION FORM

Dear Parent:

Your child will soon be involved in an exciting learning adventure - an environmental education experience at _____. Studies have shown that such "hands-on" learning programs improve children's attitudes and performance in a broad range of school subjects.

In order to make your child's visit to "nature's classroom" as safe as possible we ask that you provide the following information and sign at the bottom. Please note that insects, poison ivy and other potential risks are a natural part of any outdoor setting. We advise that children bring appropriate clothing (long pants, rain gear, sturdy shoes) for their planned activities.

Child's name _____

Does your child:

- Have an allergy to bee stings or insect bites?_____
  If so, please have them bring their medication and stress that they, or the group leader, be able to administer it.

- Have other allergies? _____

- Have any other health problems we should be aware of?_____
  _____

- In case of an emergency, I give permission for my child to be treated by the attending physician. I understand that I would be notified as soon as possible.

_____ _____
Parent's signature date

Parent's name _____ Home phone _____
(please print) Work phone _____

Family Physician's name _____ phone _____

Alternate Emergency Contact

Name_____ phone _____

NORTH CAROLINA PARKS & RECREATION
PROGRAM EVALUATION

Please take a few moments to evaluate the program(s) you received. This will help us improve our service to you in the future.

1. Program title(s) _____ Date _____
   Program leader(s) _____

2. What part of the program(s) did you find the most interesting and useful? _____
   _____

3. What part(s) did you find the least interesting and useful?_____
   _____

4. What can we do to improve the program(s)?_____
   _____
   _____

5. General comments _____
   _____
   _____
   _____

LEADERS OF SCHOOL GROUPS AND OTHER ORGANIZED YOUTH GROUPS
PLEASE ANSWER THESE ADDITIONAL QUESTIONS:

6. Group (school) name _____

7. Did the program(s) meet the stated objectives or curriculum needs? _____
   If not, why? _____
   _____

Please return the completed form to park staff. Thank you.

Duke Power State Park
Route 2, Box 224 -M
Troutman, NC 28166

Notes